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Reinsurance and the Cost of Equity in the United Kingdom's Non-Life Insurance Market

Upreti, Vineet

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Reinsurance and the Cost of Equity in the United Kingdom's Non-Life Insurance Market

Vineet Upreti

A thesis submitted for the degree of Doctor of Philosophy

University of Bath

School of Management

October 2013

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This thesis is dedicated to my parents, Vindhyavasini and Jai Dutt Upreti for their unwavering love and support.

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ABSTRACT

The link between the cost of equity and reinsurance purchased by insurers is examined in this study. This work extends the research on the economic value implications of corporate risk management practices. Utilising a framework based on the theory of optimal capital structure, this study puts forward two hypotheses to test empirically the cost of equity – reinsurance relation in the United Kingdom’s non-life insurance market. The first hypothesis tests the effect of the decision to reinsure on the insurers’ cost of equity, whereas the second hypothesis focuses on the link between the extent of reinsurance purchased and the cost of equity. Panel data samples drawn from 469 non-life insurance companies conducting business in the UK insurance market between 1985 and 2010 are used to test these hypotheses. The study employs a modified version of the Rubinstein-Leland (R-L) model to estimate the cost of equity.

Both the hypotheses put forward are supported by the empirical evidence obtained through regression analysis. The empirical results suggest that, on average, users of reinsurance have a lower cost of equity than their counterparts who do not reinsure. The results also suggest that the relationship between the cost of equity and the level of reinsurance purchased is non-linear. It is inferred from this result that reinsurance can lower the cost of equity for primary insurers provided the cost of reinsuring is lower than the reduction in frictional costs achieved through reinsurance. This finding validates the use of the theory of optimal capital structure as the appropriate framework to guide this research. Robustness and sensitivity tests confirm that the influence of multicollinearity and endogeneity on the estimates is negligible. This study thus provides new and important insights on the impact of reinsurance (risk management) on firm value through its influence on the cost of equity. These findings are deemed useful to various stakeholders in insurance companies, including investors, managers, regulators, credit rating agencies and policyholder-customers.

LIST OF ABBREVIATIONS

AEG Model	Abnormal Earnings Growth Model
APT	Arbitrage Pricing Theory
ARROW	Advanced Risk Response Operating Framework
CAPM	Capital Asset Pricing Model
DDM	Dividend Discount Model
DTI	Department of Trade and Industry
EBIT	Earnings Before Interest and Tax
ECR	Enhanced Capital Requirements
EEA	European Economic Area
EPS	Earnings per Share
EU	European Union
FF3F	Fama-French Three-Factor Model
FIB	Full Information Beta Method
FOS	Financial Ombudsman Service
FRS	Financial Reporting Standards
FSA	Financial Services Authority
FSCS	Financial Services Compensation Scheme
FSMA	Financial Services and Markets Act
GAAP	Generally Accepted Accounting Principles
GAD	Government Actuary's Department
GDP	Gross Domestic Product
GISC	General Insurance Standards Council
GLS	Generalized Least Squares
IAS	International Accounting Standards
IASB	International Accounting Standards Board
IBNR	Incurred But Not Reported
IBRC	Insurance Brokers Registration Council
ICAS	Individual Capital Adequacy Standards
IFRS	International Financial Reporting Standards
IOB	Insurance Ombudsman Bureau
IV	Instrumental Variable
KFS	Kazenski, Feldhaus and Schneider Method
MAT	Marine, Aviation and Transport
MPEG Model	Modified Price Earnings Growth Model
NAIC	National Association of Insurance Commissioners
NPV	Net Present Value
OFT	Office of Fair Trading
OLS	Ordinary Least Squares
PEG Model	Price Earnings Growth Model
PIAS	Personal Insurance Arbitration Service

PPB	Policyholders Protection Board
RBC	Risk-Based Capital
RIV Model	Residual Income Valuation Model
R-L Model	Rubinstein-Leland Model
ROA	Returns on Assets
ROE	Return on Equity
SAP	Statutory Accounting Principles
UK	United Kingdom
US	United States
WACC	Weighted Average Cost of Capital

CHAPTER 1. INTRODUCTION

1.1 Research Background

Mayers and Smith (1990) contend that the decision of direct insurers to procure reinsurance is analogous to the purchasing of insurance by non-financial firms¹. Several reasons have been reported in the literature to explain the corporate purchasing of reinsurance². These include: the need to increase the underwriting capacity and facilitate the spreading of assumed risks (Adams, 1996), to reduce the bankruptcy risk and avoid regulatory intervention in the event of a severe loss (Hoerger, Sloan and Hassan, 1990); to improve reported earnings (Adiel, 1996); to reduce expected taxes (Adams, Hardwick and Zou, 2008); to mitigate agency problems such as the underinvestment incentive (Garven and MacMinn, 1993); the provision of real advisory services (Cole and McCullough, 2006); and to signal the surety of the economic condition to the financial markets (Plantin, 2006). Like non-financial firms, property-liability insurers are mainly financed by shareholders who expect to earn a 'fair' market return on their invested capital.³ However, as Krvavych and Sherris (2006) report, frictional costs (e.g. taxes and transaction costs) mean that shareholder value is more likely to be enhanced by managing underwriting risks than by creating value from managing investment portfolios. In

¹ (Risk) reinsurance involves a primary insurer ceding a share of its annual premiums on a block of underwritten business to a reinsurance company in return for the reinsurer assuming an agreed proportion of losses that may arise (Berger, Cummins and Tennyson, 1992). In contrast, financial reinsurance invariably involves reinsurance companies providing primary insurers with an upfront capital sum representing the net present value (NPV) of liabilities with the level of premiums linked to future claims and profit emergence (Adiel, 1996).

² Powell and Sommer (2007) report that in the United States (US) property-liability insurance market approximately 80 per cent of annual reinsurance business is conducted within conglomerate groups rather than externally in the reinsurance market. Adams and Diacon (2006) estimate a similar percentage (approximately 75%) for reinsurance conducted in the United Kingdom's (UK) property-liability insurance market.

³ For example, Adams and Diacon (2006) report that approximately 95 percent of annual net premiums in the UK's property-liability insurance market are written by stock companies. A 'fair' market return in this context is defined as a return in excess of the market cost of equity (e.g., see Shimpi, 2002).

finance theory, the optimal use of (re)insurance can manifest itself by reducing the corporate cost of capital and so increase the shareholders' wealth by generating economic value in excess of the cost of capital (e.g., see Shimpi, 2002). Not only this, the management of underwriting risks is vital for insurers to outperform competition in the product-markets they operate in. As Froot (2007) suggests, insurers and reinsurers are not only subjected to the investment risk, but also to the product market imperfections arising from the inability of policyholder-customers to efficiently diversify insurable risks. Survey evidence provided by Wakker, Thaler and Tversky (1997) and Merton (1993) suggests that customers deeply (and disproportionately) discount the premium for an insurance contract for any increase in the probability of default on the part of the insurer. Hence, reinsurance can enable the insurer to command higher market premiums by reducing the probability of a default. On the other hand, reinsurance can be expensive. For example, Froot (2001) finds that due to market frictions (e.g., information asymmetries and agency costs) the price of catastrophe reinsurance coverage in the US property-liability insurance market often exceeds the actuarial value of expected losses. Schrand and Unal (1998) also opine that because of the transaction costs involved, the hedging (reinsurance) of core risks can have a deleterious effect on firm value. Therefore, rather than reduce the cost of capital (increase firm value) reinsurance could increase the cost of capital (reduce firm value). It is therefore imperative to reconcile these conflicting arguments to comprehend the effect of reinsurance on the cost of the equity of the insurers. This is the key motivation underlying this study.

1.2 Rationale for the Research Project

During the past three decades, the increasing frequency and severity of environmental perils, such as hurricanes, earthquakes, and floods have resulted in wide-scale losses for the property-liability insurance industry. For instance, the cost of insured losses resulting from super-storm Sandy in 2012, the Japanese earthquake and tsunami in 2011, and hurricane Katrina in 2005 are estimated to be USD 28 billion (Mortimer, 2013), USD 35 billion (Bevere, Enz, Mehlhorn and Tamura, 2012) and USD 41 billion (Knabb, Rhome and Brown, 2005) respectively.

Man-made disasters too have proven costly for the insurance industry. In fact, one of the largest property-liability claims in history was caused by the September 11 terrorist attacks in the US in 2001 with insured losses estimated at approximately USD 40 billion (Makinen, 2002). Moreover, the magnitude and frequency of losses caused by both natural and manmade disasters is likely to increase over time due to the increased severity and frequency of natural disasters resulting from climate change, and the emergence of new man-made perils such as cyber-terrorism (Froot, 1999; Lewis and Murdock, 1996). Indeed, Bevere et al. (2012) report that combined economic losses on the global scale due to all the disasters in 2011 were estimated at over USD 370 billion. This figure is the largest ever recorded in history, with an increase of approximately 64% over USD 226 billion of losses recorded in 2010.

This trend of rising losses from catastrophes has serious implications for the insurance industry, as it can undermine the capital adequacy of insurers to service the claims of existing customers and to underwrite new business. Moreover, for other stakeholders, such as policyholders and investors, this possibility can potentially threaten their contractual benefits as it implies an increase in insurance companies' insolvency risk and a decrease in their profitability. According to Jean-Baptiste and Santomero (2000) these concerns have resulted in an increased interest amongst managers, reinsurers, regulators, and others in better understanding the risk management and pricing techniques within the insurance industry. For property-liability (non-life) insurers, an improved understanding of risk-bearing and risk-financing is particularly important due to the potential geographical and product-market concentration of risks and the uncertainty associated with assessing and accurately pricing these risk exposures due to a lack of sufficient data and limited risk (actuarial) modelling procedures.

Prior research (e.g., Doherty, 2000; Doherty, 2005; Doherty and Tinic, 1981; O'Brien, 2006; Scotti, 2005) suggests that corporate financing and (re)insurance decisions are inextricably bound and that investigating this issue empirically could yield interesting insights into the determinants of firm value in insurance markets. For example, Doherty and Tinic (1981) show that reinsurance can reduce the probability of ruin for direct insurance writers and allow them to charge higher

premiums than would otherwise be the case, thereby increasing expected returns for shareholders. Launie (1971) also notes that knowledge of the cost of capital can help insurance managers to make more informed portfolio and capital structure decisions, and better manage financial risks. The cost of equity being an integral element of the overall cost of capital of a firm, its relationship with reinsurance is also important from the perspective of maximising the traded value of an insurer. As Sharfman and Fernando (2008) suggest, in the context of a firm's standing in the capital markets, the link between risk management and the cost of equity is a fundamental strategic issue. Similarly, Stulz (1996, p. 24) suggests that by reducing the downside financial distress/bankruptcy risks, risk management (reinsurance) can reduce the cost of equity along with increasing corporate debt capacity. Doherty and Lamm-Tennant (2009) also suggest that reinsurance being a leverage neutral post-loss financing mechanism can enable primary insurers to mitigate the adverse effects of rising losses such as the increased risks of financial distress and/or bankruptcy.

Although recent studies have examined the direct impact of (re)insurance on the value of firms using economic measures such as Tobin's q (e.g., see Zou, 2010)⁴ or market capitalization (e.g., see Scordis and Steinorth, 2012) none have examined the relation between the cost of equity capital and reinsurance. Therefore, this study could potentially contribute important insights on the interplay between the cost of capital and reinsurance that might be useful for insurance suppliers, brokers, managers, industry regulators, and investors. For example, the study could help determine the optimal level of reinsurance necessary for a particular insurance firm to reduce its cost of equity and maximize its value for its shareholders. More specifically, the two main research questions being investigated by this study are as follows:

Research Question 1: Does reinsurance affect an insurers' cost of equity capital?

Research Question 2: If it does, then to what extent does reinsurance impact on the insurers' cost of equity capital?

⁴ Tobin (1969, p. 21) defines q as ". . . the value of capital relative to its replacement cost." Scordis and Barrese (2006) view Tobin's q as a measure of a firm's investment opportunities which might proxy for other factors other than firm value such as a firm's market power.

1.3 Aim and Objectives of the Research

This research project examines the impact of reinsurance on the cost of the equity capital of UK non-life insurance companies. Stated below are the six distinct objectives that have been drawn up to achieve this aim:

1. To examine the key institutional features of the UK's non-life (re)insurance market that could influence the reinsurance – cost of equity relation.
2. To select an appropriate theoretical framework by means of an extensive review of the academic literature relating to the risk management and financing decisions of a firm.
3. To identify a suitable method to estimate the cost of equity of an insurer by reviewing the relevant accounting and finance literature.
4. To develop and test hypotheses empirically by means of univariate and multivariate (panel data) statistical analyses.
5. To explain and evaluate the empirical results.
6. To draw conclusions, and consider the implications for future research, commercial decisions and public policymaking.

1.4 Contribution of the Research

This study should contribute to the existing insurance and finance literature, and generate regulatory/practical implications in at least the following four important regards:

1. As mentioned in section 1.2 above, prior research suggests that corporate financing and risk management decisions are inextricably bound. This characteristic of investment and risk management decisions becomes critical in the case of insurers, which are systemically important regulated

financial intermediaries. This is because insurers are mandated by law to maintain a certain minimum amount of capital in order to bear assumed risks and continue operating as a going concern. Such a requirement results in the deadweight cost of capital being imposed on insurers (Froot, 2007). The contingent capital attributes of reinsurance in this case can reduce the level of retained equity and so maximize the traded value of an insurer (Doherty and Lamm-Tennant, 2009). On the other hand, Borch (1961, p. 35) points out that reinsurance is expensive for insurers because "...when an insurance company reinsures a part of its portfolio, it buys security and pays for it". In other words, reinsurance is a costly instrument. These conflicting views indicate that the purchase of reinsurance can be viewed as cost-benefit trade-off. The dynamics of the cost of equity – reinsurance relation implied by the aforementioned trade-off has hitherto remained insufficiently explored in the insurance-economics literature. Being the first study to focus on the interplay between firm-value (cost of equity capital) and risk management (reinsurance) in the non-life insurance industry, this study contributes new and important insights that might be useful for insurance suppliers, brokers, managers, industry regulators, investors, and others.

2. Most of the previous studies have focused on financial derivatives while attempting to explain the impact of risk management on firm value (e.g., see Allayannis and Weston, 2001; Gay, Lin and Smith, 2011; Géczy, Minton and Schrand, 1997; Haushalter, Klasa and Maxwell, 2007). The current study diverges from this tradition by focusing on reinsurance which is a pure indemnity contract⁵. This is in contrast with financial derivatives which can be used for speculative as well as hedging purposes (Harrington and Niehaus, 2003). Moreover, Haushalter (2000) suggests that unlike (re)insurance indemnity contracts, the use of financial derivatives for

⁵ An insurance policy is a contract of indemnity between two parties, namely the insurer and the insured, that indemnifies the insured against any losses or damages caused or suffered by the insured, conditional on the occurrence of certain events specified in the terms of the contract. In other words, a policy of indemnity is designed to place the insured in the same financial position as they would have been had the event not occurred.

hedging may not completely eliminate basis risk exposures. Aunon-Nerin and Ehling (2008) also note that derivatives data are often 'noisy' and so difficult to interpret. These characteristics make it difficult to extract relevant information from derivatives data, which is usually scarce in view of the fact that industrial firms are seldom statutorily required to disclose such information. However, these limitations concerning the amount and quality of public information are overcome in this study as regulations mandate insurers to disclose reinsurance transactions in their regulatory returns. Therefore, it follows that the 'pure-hedge' nature of reinsurance and a sufficiently large panel dataset of reinsurance transactions allow for 'cleaner' tests of the research questions posed in this study.

3. Being one of the largest insurance markets in the world, (the 3rd largest in terms of annual premiums written) the UK is an important market in which to conduct this research. Other features of the UK insurance market that make it interesting are its unitary regulatory and fiscal regimes. These characteristics of the UK insurance market further enable potentially robust and reliable tests of the research questions this study aims to answer. This is because the entire market is subjected to the same insurance company regulations in contrast to some other markets, such as the US, where industry and tax-based regulations (e.g., concerning reserving policies) can vary from state to state. Further, the absence of both the premium rate regulation and the mandatory purchase of reinsurance (e.g., as exists in some emerging insurance markets such as China and India) removes the bias induced by such regulatory practices, thereby improving the reliability of the statistical analyses carried out.
4. Since investment financing and risk management decisions go hand in hand, it is important to control for potential endogeneity induced by such a relation. This study therefore tests the cost of equity – reinsurance relations using a battery of tests to ensure the validity of the results. Moreover, an instrumental variable technique is employed to ensure the robustness of the results. Further, a novel technique combining the full information beta

method of Kaplan and Peterson (1998) and the non-parametric method of equity beta estimation (Wen, Martin, Lai and O'Brien, 2008) is devised for this study. This study is the first to employ such a procedure for examining the cost of equity - reinsurance relations in the non-life insurance sector, both in the UK and overseas.

1.5 Research Methods

To achieve the stated aim and objectives of the project, a combination of literature-based and empirical research methods are employed as follows:

1. A search and analysis of the relevant literature leading to the selection of an appropriate theoretical framework to guide the empirical analysis.
2. A statistical analysis of the panel data for the period 1985-2010 using data from public sources such as the Standard & Poor's UK Insurance Companies Database – SynThesys, and the Datastream database provided by Thomson Reuters. The data used in this study are analysed using descriptive and univariate and multivariate statistics. Robustness tests, including a two-stage instrument variable (IV) approach, are also conducted to control for potential endogeneity problems.
3. The study utilises the recent cost of (equity) capital metrics reported in the literature including accounting-based valuation models (e.g., Botosan and Plumlee, 2002) and financial economics-based asset pricing models (e.g., Leland, 1999; Rubinstein, 1976).

1.6 Assumptions

The study is predicated on five main assumptions as follows:

1. Insurance company managers have the discretion to vary the level of reinsurance purchased independently of legislators, regulators and other external constituents (e.g., investors). This assumption is considered to be

justified as, unlike some emerging economies, (e.g., China and India) the UK's Insurance Companies Regulations (1994) do not prescribe statutory minimum levels of reinsurance for direct insurance writers.

2. Restrictions in the supply of reinsurance do not severely distort the reinsurance decisions of managers. Prior studies (e.g., Blazenko, 1986; Borch, 1961, 1962) have also assumed that reinsurance markets are competitive and efficient so that the market supply of reinsurance effectively adjusts to consumer demand. Indeed, Cummins (2007) reports that although the reinsurance market can be susceptible to underwriting cycles and price variations over time, it is a global market and international investors tend to respond quickly to the capital needs of reinsurance markets.
3. The financial data to be analysed in the present study derive from independently audited annual solvency filings made by insurance companies to the UK insurance industry regulator at the time, the Financial Services Authority (FSA)⁶. Therefore, the data to be used in this study are assumed to be reliable.
4. Observed cession rates (i.e., reinsurance purchases) are assumed to be representative of inherent demand for reinsurance, and not to be unduly affected by the prevailing market price of reinsurance. Implicit in this assumption is the view that premiums ceded each year reflect the demand for reinsurance arising as a result of portfolio assessment by managers, rather than period-specific (cyclical) movements in prices. This assumption is consistent with prior academic research pertaining to insurance (e.g., see Zou and Adams, 2006, 2008). This is a reasonable assumption because for correctly priced risks, a positive correlation is expected between annual amounts of premium and levels of indemnity coverage (Zou, 2003).

⁶ On 1 April 2013 the Prudential Regulation Authority (PRA) became responsible for the prudential regulation and supervision of banks, building societies, credit unions, insurers and major investment firms. The Financial Conduct Authority, a separate body, is responsible for business and market conduct.

5. Very few companies operating in the UK non-life insurance market are listed entities (currently $n \sim 25$). Therefore, betas for six major classes of non-life insurance are estimated to facilitate the calculation of firm-level betas. It is assumed that product-market betas so calculated are common to all the firms. Furthermore, overall company betas based on business line level betas provide a reasonable representation of the risk profile of each firm. This approach is deemed appropriate as prior studies (e.g., Cummins and Phillips, 2005) have advocated such an approach where mark-to-market accounting based estimates are not available.

1.7 Scope of the Project

The scope of the project is defined in two key regards as follows:

1. The study focuses on UK-licensed property-liability insurance companies purchasing reinsurance in six main lines of insurance business: personal accident; motor insurance; property insurance; liability insurance; marine, aviation & transport insurance; and miscellaneous and financial loss insurance. Insurance syndicates operating in the Lloyd's of London market are excluded from this study, as comparable financial data for these insurance carriers are not publicly available.
2. The proposed time span of the study covers the 26 years, 1985 – 2010, which represents the earliest and latest years for which complete data are available to enable the analysis to be conducted in a timely manner.

1.8 Outline of the Thesis

The thesis is organised as follows:

Chapter 1. Introduction: This chapter provides background information on the research project and identifies the main gaps and issues in the literature that need further investigation. The aim and objectives of the study, the contribution to

knowledge, and a description of research methods employed are also stated in this chapter. The underlying assumptions and the scope of this study are also addressed. The remainder of the thesis is divided into seven chapters as documented below.

Chapter 2. Institutional Background: This chapter provides background information about the institutional environment in which UK non-life insurance companies operate. The chapter also outlines the key elements of regulatory and accounting practices that prevailed during the period of analysis (1985-2010). In addition, the institutional merits of the UK's insurance market as a research environment are examined in this chapter of the thesis.

Chapter 3. Literature Review: This chapter of the research project identifies and reviews (critiques) the main theories that have been used in extant literature to explain the existence of, and 'value-added' provided by corporate risk management especially in the context of the insurance industry. From this review, the theory of optimal capital structure is selected as the most appropriate conceptual framework within which to guide and direct the empirical analysis.

Chapter 4. Hypotheses Development: This part of the thesis elaborates upon the theory of optimal capital structure, and uses this exposition to derive and specify two main hypotheses to direct the empirical analyses conducted in Chapter 7.

Chapter 5. Cost of Equity Metrics: This chapter reviews (critiques) the main cost of equity metrics documented in the accounting and financial economics literature. This review enables the selection of appropriate metrics to facilitate empirical tests of the hypotheses forwarded in Chapter 4.

Chapter 6. Research Design: This chapter begins by examining the rationale for selecting statistical analysis as the research method for this study. The chapter then describes the dataset chosen for the analysis and the sample selection method employed. This is followed by a discussion of the procedure adopted for estimating the cost of equity of UK non-life insurers. Subsequently, definitions of variables used, respective models used to test the two hypotheses, and the econometric procedures employed to implement these models are presented in this chapter.

Chapter 7. Empirical Results: This chapter analyses the results and evaluates them in relation to the test hypotheses and the existing literature. Initially, the data are described using descriptive statistics, followed by a bivariate analysis to establish the correlation between the variables used. Finally, regression analysis and various robustness and sensitivity tests (e.g. IV analysis) are conducted to test the two hypotheses relating the cost of equity of insurers to the purchase of reinsurance.

Chapter 8. Summary and Conclusions: This chapter summarises the key results, draws conclusions from the empirical analysis, considers the limitations of the study and outlines the implications of the study's findings for future academic research, and strategic commercial decisions and/or public policymaking.

CHAPTER 2. INSTITUTIONAL BACKGROUND

2.1 Introduction

This chapter describes the salient characteristics of the UK insurance industry over the 26 years duration of this study (1985-2010). The chapter begins by presenting the development of the UK non-life and life insurance sectors in terms of annual premiums written, and the role they play in the wider economy. The chapter also presents an overview of the current regulatory and accounting framework under which UK insurance companies operate and tracks its historical development. Additionally, this chapter establishes the suitability of the UK non-life insurance market as an environment within which to conduct this study.

2.2 The UK Insurance Market

Since its inception in the fifteenth century as a cluster of small firms dealing primarily in marine insurance, the insurance industry in the UK has grown to become one of the major insurance markets in the world (Hardwick and Guirguis, 2007). Accounting for nearly 7 percent of the world wide premiums written (including both the life and non-life insurance sectors), the UK insurance market is currently the third largest in the world (after the US and Japan) and the largest in Europe (Seiler, Staib and Puttaiah, 2013). Representing around 16 percent of the annual premiums written in the continental European non-life market and 5.3 percent of the world non-life insurance market makes the UK the second largest property-liability insurance market in Europe and the fourth largest in the world (after the US, Japan and Germany). Table 2.1 shows the development of the UK insurance market along with the European and worldwide insurance market during the period 2000-2012.

Table 2.1: The Development of Insurance Premiums: UK, Europe and the World

Year	World	Europe	United Kingdom		
	Premium Volume (USD mln.)	Premium Volume (USD mln.)	Premium Volume (USD mln.)	Share of World Market (%)	Share of European Market (%)
Total Insurance Market					
2000	2,444,903	786,089	246,899	10.10	31.41
2001	2,415,720	767,432	219,421	9.08	28.59
2002	2,632,473	846,697	236,833	9.00	27.97
2003	2,958,359	1,035,838	254,363	8.60	24.56
2004	3,264,158	1,206,191	292,199	8.95	24.22
2005	3,445,816	1,335,057	336,158	9.76	25.18
2006	3,674,892	1,455,509	361,790	9.84	24.86
2007	4,127,586	1,764,685	539,468	13.07	30.57
2008	4,220,070	1,703,713	395,687	9.38	23.22
2009	4,109,635	1,614,385	312,165	7.60	19.34
2010	4,335,687	1,615,190	300,242	6.92	18.59
2011	4,566,163	1,625,442	312,843	6.85	19.25
2012	4,612,514	1,535,176	311,418	6.75	20.29
Non-life Insurance Market					
2000	926,503	282,924	60,319	21.32	6.51
2001	969,745	299,620	65,668	21.92	6.77
2002	1,098,412	346,207	77,076	22.26	7.02
2003	1,275,616	438,008	93,143	21.27	7.30
2004	1,397,522	501,095	99,003	19.76	7.08
2005	1,442,258	522,830	105,126	20.11	7.29
2006	1,549,100	573,703	104,899	18.28	6.77
2007	1,685,762	649,538	115,725	17.82	6.86
2008	1,780,776	707,615	109,515	15.48	6.15
2009	1,742,193	660,968	95,446	14.44	5.48
2010	1,819,310	658,573	99,671	15.13	5.48
2011	1,954,445	686,938	104,110	15.16	5.33
2012	1,991,650	658,732	105,500	16.02	5.30

Source: Adapted from Baez and Staib (2007); Birkmaier and Codoni (2002, 2004); Codoni (2001); Enz (2006); Lorenzo and Lauff (2005); Schlag and Codoni (2003); Seiler et al. (2013); Staib and Bevere, (2008, 2009, 2010, 2011). This table presents total (gross) annual premiums written, expressed in nominal values of US Dollars, at Worldwide, European and UK National Levels, for the period 2000-2012. The percentage market share of the UK at worldwide and European levels is also reported.

As is evident from the data presented in Table 2.1, the UK's share of both the world insurance market and the European insurance market has gradually reduced over the last decade. Despite this apparent loss of market share, the UK has maintained its rank as the third largest insurance (total) market and fourth

largest property-liability insurance market in the world. Interestingly, the non-life insurance sector performed better than the total UK insurance market over the 2001-2012 period as shown in Table 2.2. During this period, the total UK insurance market experienced large negative inflation adjusted growth rates in several years, whereas the non-life market experienced either positive or relatively benign negative annual growth rates. Moreover, the UK insurance market has one of the highest levels of insurance penetration in the world. According to Seiler et al. (2013), insurance penetration (measured by expressing annual premiums written as a percentage of GDP) in the UK is more than 11 percent with non-life insurance premiums amounting to nearly 3 percent of the GDP in 2012.

Table 2.2: Growth of the UK Insurance Market, 2001-2012

Year	Total Insurance Market			Non-life Insurance Market		
	Premium Volume (£ mln.)	Nominal Growth (%)	Inflation Adjusted Growth (%)	Premium Volume (£ mln.)	Nominal Growth (%)	Inflation Adjusted Growth (%)
2001	152,243	-7.1	-8.7	45,564	14.4	12.3
2002	157,636	3.5	1.9	51,305	12.6	10.8
2003	158,418	-1.3	-2.6	56,996	11.1	9.6
2004	159,515	0.7	-0.6	54,047	-5.2	-6.4
2005	184,730	15.3	13.0	57,770	6.3	4.2
2006	196,320	10.2	7.7	56,922	-1.5	-3.7
2007	269,494	25.8	22.9	57,811	1.6	-0.7
2008	213,529	-20.8	-23.5	59,108	2.2	-1.3
2009	199,450	-6.6	-8.6	60,983	3.2	1.0
2010	194,205	-2.5	-5.6	64,470	6.1	2.8
2011	195,141	0.5	-3.8	64,940	0.7	-3.6
2012	196,444	0.7	-2.1	66,550	2.5	-0.3

Source: Adapted from Baez and Staib (2007); Birkmaier and Codoni (2002, 2004); Codoni (2001); Enz (2006); Lorenzo and Lauff (2005); Schlag and Codoni (2003); Seiler et al. (2013); Staib and Bevere (2008, 2009, 2010, 2011). This table presents total (gross) annual premiums written, expressed in nominal values of Pounds Sterling in the UK insurance market, for the period 2001-2012. Nominal and inflation adjusted annual percentage growth rates for this period are also reported.

The UK insurance industry currently controls financial assets valued approximately at £2.7 trillion, and contributes to the UK economy by directly investing nearly 54% of this amount in the UK economy in the form of various financial investments (Office for National Statistics, 2013). The UK insurance industry is additionally a major exporter for the UK economy with premium income valued at £41 billion

coming from overseas, of which nearly £14 billion are attributed to general insurance business (Association of British Insurers, 2012c)⁷. The non-life insurance market in the UK can be divided into two major constituencies, namely the domestic insurance market and the London market. The domestic insurance market caters to the insurance needs of households and businesses in the UK, whereas the London market is largely international with a significant proportion of business attributable to reinsurance. The London market includes Lloyd's and the company market. The purpose of the company market is to allow brokers to place risks through a number of corporate insurers. On the other hand, prospective policyholders cannot approach a Lloyd's syndicate directly, and the business must be placed only through authorised Lloyd's brokers. This apparent segregation of these markets however does not prevent some overlap between the respective markets. For example, a large or unique risk may simultaneously be placed with corporate insurers in the company market and Lloyd's syndicates (General Insurance Manual, 2008). Given such a vibrant insurance market, there are currently about 700 insurance operatives authorised to conduct business in the UK's non-life insurance market (Association of British Insurers, 2012c). Details of the structure of the UK's insurance market are also provided in Table 2.3⁸.

The data presented in Table 2.3 underscore the point that the UK's insurance industry has not been static during this period. The absolute number of operatives in the general insurance sector is far higher than the ones operating in the long term insurance sector, which might signify the fact that there are many specialist insurers in the general insurance business who tend to operate within their respective areas of expertise. Prior to 2005, the number of regulated firms was based on categories the FSA inherited from its predecessor sectoral regulators,

⁷ Figures do not include premiums written by insurance companies that are not members of Association of British Insurers, and premiums written in Lloyd's market.

⁸ However, only about 300 out of the 700 or so non-life insurers are actively writing commercial insurance business. The remainder are comprised of closed funds in run-off, trust funds, branches of overseas insurance entities and branches/'fronting' companies of overseas financial entities authorised to operate in the UK under international trade agreements (e.g., various promulgations of the EU's Non-Life insurance Directives). These branches/'fronting' companies are subject to insurance regulations in their home country rather than to those of the UK's regulatory authorities.

while post-2005 the FSA annual reports presented the data based on the primary business carried out by each regulated firm allowing for year-on-year comparisons to be made. For this reason, an abrupt change in the number of regulated entities is encountered from the year 2004 to the year 2005 in Table 2.3, and makes pre-and-post 2005 figures incomparable. Furthermore, a clear pattern of decrease in the number of regulated insurance entities after the year 2005 suggests that the industry has, in recent years, undergone a consolidation through mergers & acquisitions, and market exits. As with the number of companies, the size of the market (estimated using annual premiums underwritten) has also been dynamic over the period of study.

Table 2.3: Number of Insurance Operatives in the UK, 2001-2010

Year	Property-Liability Insurers					Composite Insurers	Life Insurers	Total	Of which Lloyd's Firms
	UK Firms	UK-supervised non-UK EEA firms	Home state-supervised non-UK EEA firms	Non-EEA firms	Sub-total P&L Insurers				
2001	441	5	81	67	594	56	160	810	-
2002	443	5	81	66	595	56	161	812	-
2003	440	5	83	64	592	54	160	806	-
2004	420	4	83	61	568	45	159	772	-
2005	431	69	307	63	870	60	422	1352	-
2006	412	64	301	59	836	50	232	1118	83
2007	384	68	279	57	788	47	215	1050	82
2008	372	63	273	54	762	46	209	1017	79
2009	361	60	263	51	735	44	193	972	78
2010	349	54	248	50	701	43	190	934	72

Source: Financial Services Authority, 2002-2010. This table provides the number of insurance companies (including Lloyd's firms) and brokers operating in the UK during the 2001 – 2010 period. Property-liability insurers and brokers are divided into 4 categories: UK firms; EEA companies with a head office outside the UK but supervised in the UK; EEA companies with a head office outside the UK with home state control; companies, whose head office is not in the EEA area. Data on the number of Lloyd's firms before 2006 are not reported in FSA Annual Reports or publicly available Lloyd's sources.

General (non-life) insurance covers a wide range of risks usually through the use of fixed term contracts (policies) which are utilised by both businesses and individuals. Owing to the variety of risks covered, the general insurance industry is characterised by several different lines of business, chiefly among which are

motor; personal accident; property; general liability; pecuniary loss; marine, aviation and transport (MAT) insurance; and reinsurance. Table 2.4⁹ presents variations observed in annual premiums written by lines-of-business for the period 2006 to 2011. These data show that motor, and property insurance are the most significant lines-of-business in terms of annual premiums generated. Interestingly, the contribution of non-MAT reinsurance towards the total figure has substantially increased over time, which may be due to a combination of several factors such as the emergence of new risks, demand for increased capacity and contingent capital.

Table 2.4: UK General Insurance Premiums by Risk Type

		2006	2007	2008	2009	2010	2011
UK Risks (£ mil.)	Motor	10,320	10,527	10,696	9,910	10,585	11,658
	Personal Accident	4,385	4,620	4,644	4,403	4,441	4,420
	Property	8,487	8,609	8,848	8,207	8,375	8,646
	General Liability	3,273	3,353	3,834	3,242	3,011	3,100
	Pecuniary Loss	3,999	4,101	3,658	2,705	3,092	3,205
	Total	30,464	31,211	31,680	28,468	29,505	31,029
	Home-Foreign¹⁰	1,076	1,236	1,603	1,451	1,747	1,769
	Non-MAT Reinsurance	362	894	1,329	1,314	1,480	964
Marine, Aviation & Transport (£ mil.)		344	640	876	1,028	1,051	1,330
Lloyd's		16,410	16,360	17,980	21,970	22,600	23,500
Grand Total (£ mil.)		48,656	50,341	53,467	54,231	56,382	58,592

Source: (Association of British Insurers, 2012a). This table presents total net annual premiums written, expressed in nominal values of Pounds Sterling in the UK insurance market, for the period 2006-2011.

The UK non-life insurance market is dominated by large companies with the cumulative market share of the top ten insurance providers amounting to

⁹ Figures include premium estimates for non-members of the Association of British Insurers and Lloyd's syndicates.

¹⁰ Home foreign general insurance business carried on in the UK primarily relating to risks situated outside the UK, but excluding marine, aviation and transport business, treaty reinsurance business and business where the risk commences in the UK.

approximately 67% of the annual premiums written in 2011. The top five non-life insurers, namely Aviva (13%), the Direct Line Group (10%), AXA (9%), RSA Group (9%) and Allianz (5%) account for more than 46% of the general insurance premiums written (Association of British Insurers, 2012b). Insurers employ a range of distribution channels to generate their revenues viz., insurance brokers, company agents, direct selling, bancassurance, and independent financial advisors (IFA's). Independent intermediaries like insurance brokers and independent financial advisors play a crucial role in the insurance market which becomes evident from the fact that they were instrumental in getting 40% of non-life and 78% of long-term risks placed respectively with the insurers in 2012 (Association of British Insurers, 2012c). In 2011, direct sales accounted for 31% of premiums generated in the non-life insurance market, whereas only 13% of the long-term risks underwritten were non-intermediated (Association of British Insurers, 2012c).

The market statistics presented above bring to the fore the strong influence the insurance industry exercises on the UK economy. Therefore, it's important that this industry is well regulated and remains competitive in the international market. As the market size and composition have evolved over time, it's only natural that the regulatory environment also follows suit. The next section thus discusses the salient regulatory features of the UK insurance industry and emphasises the regulatory environment prevailing during the years 1985 to 2010 that are covered in the present study.

2.3 Regulatory Environment

2.3.1 Historical Development

Initial attempts to regulate the insurance industry in the UK can be traced back to 1575 which marks the establishment of the Office of Assurances (in the Royal Exchange) to coordinate and control the writing of insurance (primarily marine insurance) (Daykin and Cresswell, 2000). With the development of life insurance in subsequent centuries, the Life Assurance Companies Acts were passed in the years 1870 and 1872 with the purpose of insulating life insurance business from

general insurance business in the case of composite insurance companies. Carter and Falush (2009) provide an account of the regulatory environment prevailing in the UK since the year 1900 in some detail. They point out that based on the principle of 'freedom with publicity', regulatory activity in the twentieth century is largely characterised by a policy of minimum intervention to encourage innovation, healthy competition, and the minimisation of the costs of regulatory burden. However, towards the final decades of the twentieth century, an emphasis on the protection of the interests of customers triggered some regulatory action not entirely in accordance with the aforementioned principle. For example, the protection of the interests of consumers is one of the objectives mentioned under the Financial Services and Markets Act (2000).

The continuing failures of general insurance companies in the first decade of the twentieth century prompted recognition of the need to extend prudential regulations to the non-life insurance sector by the passage of the Employers' Liability Insurance Companies Act (1907) (Carter and Falush, 2009). Following this, the enactment of the Assurance Companies Act (1909) underscored the extension of regulations beyond life insurance to include fire insurance; accident insurance (personal accident and sickness); employers' liability insurance; and bond investment business. This act followed the main provisions of the 1870 Assurance Act. In addition, it prescribed the form of the insurance companies' revenue accounts and balance sheets. However, Lloyd's and marine insurance were kept out of the purview of this act due to the specialist nature of the business and the separate Acts of Parliaments governing the Lloyd's market. Subsequent acts such as the Industrial Assurance Act (1923), the Road Traffic Act (1930), and the Air Navigation Act (1936) brought industrial life assurance, motor insurance and aircraft insurance under the scope of the 1909 Act as separate classes of business. The 1909 Act was further strengthened by the enactment of the Assurance Companies (Winding Up) Acts of 1933 and 1935 by giving the erstwhile insurance industry regulator - the Board of Trade - powers to intervene in cases of financial distress and/or insolvency.

In the aftermath of World War II, the Assurance Companies Act (1946) brought marine, aviation and transport insurance under a regulatory framework and

classified the insurance industry into two different classes: long term business, covering all life assurance and bond-investment business; and general business covering all of the other classes of business under the regulatory supervision of the Act. This Act was further consolidated by the passage of the Insurance Companies Act (1958), which required UK insurers to prepare separate revenue accounts for life assurance, industrial life assurance, employers' liability insurance and bond investment business and for receipts from each class to be carried to a separate fund (Carter and Falush, 2009). However, insurance company failures in the 1960s and 1970s prompted the passage of Part II of the Companies Act (1967) and the Insurance Companies Amendment Act (1973). The advancements achieved by these Acts were to bring all the classes of insurance within the scope of regulations. The statutes also strengthened the powers of the Department of Trade & Industry (DTI) over the authorisation of new companies; increased the minimum paid up share capital as well as the solvency margin for general insurance companies; restricted the corporate ownership, directorship and control of insurance companies to 'fit and proper persons'; and empowered the DTI to grant authorisations subject to certain restrictions¹¹. These Acts were followed by the enactment of the Insurance Companies Act (1974) which was consolidatory in nature. The significance of the 1974 Act lies in the fact that it was passed just after the UK became a part of the European Communities (which later came to be known as the European Union (EU)) in 1973. Hence, the 1974 Act was instrumental in aligning the UK regulation with the First Non-Life Insurance Directive (Council Directive - 73/239/EEC, 1973) that had already been negotiated by the six founding countries of the EU. According to Daykin and Cresswell (2000, p. 3) "The essence of the non-life establishment directive was to create a common solvency regime to underpin the mutual recognition of supervisory systems". The key features of this Directive and subsequent EU Directives are discussed in section 2.3.3 below. The next significant piece of insurance legislation was the Insurance Companies Act (1982) which is discussed further in section 2.3.2 below.

¹¹ The 'fit and proper' person test ensures that the person holding a position of responsibility within the insurance company is honest, financially sound and competent to hold such a position.

2.3.2 Insurance Companies Act, 1982

The Insurance Companies Act (1982) consolidated all of the previous legislation pertaining to insurance and introduced new regulations (e.g., providing rules for the transfer of business between insurers) as well. Hardwick and Guirguis (2007, p. 207) report that the "...overall objective of the legislation was to ensure that only 'fit and proper' persons should transact insurance business". The 'fit and proper' persons test for authorisation was extended to include underwriting agents; and the DTI was given new powers to withdraw authorisations. Companies were also required to disclose more information about their reinsurance transactions in relation to their general insurance business in their annual returns. The prudential supervision of UK insurance companies under the 1982 Act was originally carried out by the DTI, and later by the Treasury. Another important step in the regulation of the insurance companies was taken in 1996 when insurers were allowed to maintain 'equalization reserves'¹² after the passage of the Insurance Companies (Reserves) Act (1995). These reserves qualified for tax relief in respect of specified classes of insurance business (e.g., property insurance) exposed to catastrophe losses.

2.3.3 The European Union Directives

The EU directives, developed in consultation with member states, are based on the underlying principles of the freedom of establishment and the freedom to provide services (Hardwick and Guirguis, 2007). As mentioned in section 2.3.2 above, the first non-life insurance directive was passed in the year 1973. Under this regime, each UK-based insurance company was to be supervised in respect of its entire (worldwide) business by the supervisory authority in the member state where the head office was situated. Foreign domiciled companies (with a non-EU head office) were subject to different solvency margins. Relying on the monitoring of these solvency margin requirements by the home country supervisor, insurance companies could establish branches in other EU member states. Thus, the host country supervisor could focus only on the financial health of the branch of the

¹² An equalisation reserve helps to mitigate claims volatility in respect of non-life insurance business. The annual change in the equalisation provision is recorded in the profit and loss accounts for the year.

insurance company operating within its jurisdiction irrespective of the overall financial condition of the company. Daykin and Cresswell (2000, p. 3) report that "...the required solvency margin for general (property/casualty) insurance companies is calculated as 18% of the net premium up to 10 million Euros (formerly écus) of premium income, and 16% of the premium income above that level. An alternative basis of calculation involving 26% of the net incurred claims up to 7 million Euros, and 23% of claims above that level, applies if it yields a higher result". They further state that it is a simplified estimation as reinsurance could only be taken into account in reducing the gross premium (or claims) by a maximum of 50%. However, there were no rules laid out by the directive pertaining to the valuation of either assets or liabilities, as these were left within the jurisdiction of the supervisory authorities and/or regulations of the individual member states. Apart from this, a clear basis for regulatory intervention by insurance industry supervisors was laid out in the 1973 EU directive, which was based broadly on the maintenance of the minimum margin of solvency. As soon as this minimum level of solvency margin was breached, the concerned regulator could ask the company to prepare and implement a plan for achieving the minimum solvency margin. Another trigger point embedded within this regime was set at one-third of the required minimum margin, subject to a minimum in absolute money terms (according to the class of business). This level was called the guarantee fund and if the excess of assets over liabilities fell below this level the company would be required by the regulator to prepare a short term financial scheme, which would imply a capital injection or capital reconstruction, or sale of the business. The supervisor could withdraw a company's license to underwrite new business in case it failed to establish such an arrangement expeditiously (General Insurance Manual, 2008).

The second EU directive (Council Directive - 88/357/EEC, 1988) was instrumental in opening up the commercial insurance market within member states, which was just a minor advancement to the existing regime. Following this, a major breakthrough to create a single insurance market within Europe was achieved in 1992 with an agreement being reached on the third Non-Life Directive (Council Directive - 92/49/EEC, 1992). This directive became effective on 1 July 1994 and

achieved “freedom of services“, enabling insurance companies to carry out business in host countries without establishing a branch in the host country. The differences in asset and liability valuations were also resolved in principle for general insurance business by the passing of the EU Insurance Accounts Directive (Council Directive - 91/674/EEC, 1991). However the interpretation of these principles may differ from country to country. For example, article 56 of the EU Accounts Directive requires that “...the amount of technical provisions must at all times be such that an undertaking can meet any liabilities arising out of insurance contracts as far as can reasonably be foreseen“, which is open to differing interpretations. However, the 1992 EU Directive did legitimise the discounting of provisions for general insurance, especially for business with a mean outstanding settlement term of four years or more, although the decision to implement it was left at the discretion of the member states. These Directives introduced a single European passport which allowed any properly authorised EU-headquartered insurance company to conduct business throughout the EU (Beckmann, Eppendrofer and Neimke, 2003). These third generation EU Directives were also instrumental in promoting the mutual recognition of authorisation and supervision agreements by the various states of the EU (Seatzu, 2003). This resulted in the creation of a large insurance market without any restrictions on price or product being offered, allowing for competition in the EU insurance market to flourish (Van Der Ende, Ayadi and O'Brien, 2006).

The EU Reinsurance Directive (Directive - 2005/68/EC 2005) which became operational on the 10 December 2007 throughout the EU was also drafted along the same lines as previous EU Insurance Directives and created a single market for pure reinsurers within the EU member states. These three non-life insurance directives and the reinsurance directive will be recast into one new legislative provision, as part of the Solvency II framework when the latter becomes operational (currently estimated to be 1 January 2016).

2.3.4 Financial Services and Markets Act, 2000

As has been mentioned in section 2.2, for many years the Insurance Division of the DTI carried out insurance regulation in the UK under the framework of the

Insurance Companies Act (1982) and subsequent regulations. The UK Treasury took over this responsibility in January 1998 and in January 1999 the supervisory activity was delegated by the Treasury to the FSA. In accordance with the new legislation called the Financial Services and Markets Act (FSMA), 2000 full responsibility for the supervision of financial institutions, including insurance companies, was assumed by the FSA in 2001. Following the passage of this Act, a risk based approach to calculating capital adequacy gained prominence. The FSA ensured that insurers maintain adequate financial reserves to meet any foreseeable liabilities and are run only by approved persons who are deemed to be 'fit and proper'. This Act covers much of the details of all the previous legislation pertaining to the insurance industry apart from amalgamating various ombudsman schemes into the Financial Services Ombudsman Scheme as well as combining various compensation schemes, including the Policyholders' Protection Board, into the Financial Services Compensation Scheme. Using this approach, the FSA sought to attain the following regulatory objectives as mentioned in the FSMA, 2000:

1. Maintaining confidence in the investment markets;
2. Improving consumer awareness;
3. Helping to protect consumers;
4. Reducing financial crime.

However, the principles based risk assessment approach to regulation gained prominence in subsequent years, which is underscored by the adoption of Individual Capital Adequacy Standards (ICAS) by the FSA in 2005 in anticipation of the implementation of a more principles-based system of regulation as envisioned in the 'Solvency II' regime (General Insurance Manual, 2008).

2.3.5 Solvency II

Due to the deficiencies of the existing risk-based approach which failed to differentiate between different types of risks in terms of timing and the scale of claims, the European Commission initiated work on a new set of regulations in 2000¹³. These new regulations followed a principles-based approach to risk

¹³ For example, commercial insurance, such as aviation, marine and energy, can be more volatile compared with the motor line of insurance as the number of risks is relatively small and very large values are often concentrated in a single location (Thoyts, 2010).

assessment and regulation. This resulted in regulatory changes being implemented in a phased manner in the EU's insurance markets. In the first stage, Solvency I regulations were implemented across Europe in January, 2004. Solvency I standards provided a rules-based set of minimum capital requirements, along with addressing many of the coordination issues among sovereign regulatory agencies. As the Solvency I regime is based on the First Non-Life Insurance Directive (Council Directive - 73/239/EEC, 1973), it offered relatively few modifications to the capital standards originally introduced by this directive.

Given the shortcomings of Solvency I, a comprehensive set of regulations called Solvency II (Directive - 2009/138/EC, 2009) are being developed. Tarantino (2008) opines that the Solvency II proposals are likely to produce a more consistent solvency standard for insurers, while establishing a single set of rules governing insurer creditworthiness and risk management. The three pillar approach adopted by the Solvency II regime is very similar to Basel II banking regulations (KPMG, 2002). The first pillar deals mainly with the financial requirements imposed under the Solvency II initiative. Designed to ensure that a firm is adequately capitalised to deliver policyholder protection, Pillar I specifies how the capital requirement is set and assessed and how the eligible capital resources of the firm are determined (Eling, Schmeiser and Schmit, 2007). The second pillar imposes higher standards of risk management and governance on firms. According to Linder and Ronkainen (2004), Pillar II emphasises the principles for the internal control and sound risk management of insurance undertakings, and enumerates conditions for supervisory intervention. This pillar also encourages insurance firms to initiate their Own Risk and Solvency Assessment (ORSA) which requires them to undertake a forward-looking assessment of their risks and the adequacy of capital resources. The third pillar aims for greater levels of transparency for supervisors and the public (KPMG, 2002). By ensuring better and more up-to-date information on a firm's financial position, Pillar III aims to instil greater market discipline resulting in greater market transparency. According to Eling et al. (2007) the market transparency so achieved will result in the reduced requirement of regulatory intervention.

Even though Solvency II had been adopted by the EU in November 2009, its implementation has not been possible yet. Upon adoption, the initial

implementation date was set on November 1, 2012. Further amendments were introduced through the Short Directive (Omnibus II) in July 2012, and the original implementation date was changed to January 1, 2014. It is likely that the implementation date will further be postponed to January 1, 2016. As mentioned in section 2.3.4, the FSA had implemented the ICAS on January 1, 2005. To align the regulatory process with the ICAS, the FSA in 2004 had a project for a comprehensive risk management approach called ARROW (an acronym for Advanced Risk Response Operating Framework), which was later changed to ARROW II in 2006. Similar to Solvency II, the FSA's ARROW framework consists of three components: the risk assessment of individual firms; the risk assessment for several firms or the market as a whole; and internal risk management to assess the operational risks within the FSA. Thoys (2010) suggests that this framework ensures capital adequacy and sound risk management practices in insurance companies.

2.3.6 Consumer Protection and Dispute Resolution

As noted in section 2.3.1, 'freedom with publicity' was the governing principle behind the UK insurance regulations during most of the twentieth century. However, owing to some corporate failures there was a gradual shift from this principle in the direction of proactive regulation and protecting the interests of policyholders (mainly individuals). One key statute in this regard was the Policyholders Protection Act (1975) which led to the establishment of the Policyholders Protection Board (PPB) with powers to impose a levy on authorised insurance companies transacting the type of insurance concerned (and in certain cases on insurance intermediaries too) to enable the Board to make payments to private policyholders in respect of contracts effected in the UK with an authorised insurer that goes into liquidation or is unable to pay its debts. Later, this act was amended by the Policyholders Protection Act (1997). However, this again was replaced by the Financial Services Compensation Scheme (FSCS), constituted under the FSMA (2000).

Another source of financial losses experienced by the policyholders may be the negligence committed by an intermediary in placing the insurance policy or in

handling a claim. To protect against such losses, the Insurance Brokers (Registration) Act (1977) was passed, which required the intermediaries to register with the Insurance Brokers registration Council (IBRC) to be able to use the title 'insurance broker'. These registered brokers could be ordered by the IBRC to compensate policyholders who suffered financial losses due to brokers' actions. Subsequently, the IBRC was abolished by the government and the General Insurance Standards Council (GISC) was formed, representing all sections of the industry in an attempt to promote self-regulation. The GISC was instrumental in creating unified standards for all methods of distribution within the insurance industry. In January 2005, the FSA took over the regulatory role of the GISC.

Apart from the statutes mentioned above, another route to ensure consumer protection was provided by the Office of Fair Trading (OFT), which was established following the enactment of the Fair Trading Act (1973). The OFT was required to keep a 'close watch' on business practices affecting consumer interests; to encourage businesses to comply with the competition and consumer law; and to recommend remedial action, where necessary.

Focussing on the interests of personal policyholders, the insurance industry set up the Insurance Ombudsman Bureau (IOB) and the Personal Insurance Arbitration Service (PIAS). These bodies referred disputes for arbitration with awards being binding on both the parties in accordance with the Arbitration Acts, however, with limited right to appeal. On 1 December 2001, the Financial Ombudsman Service (FOS) was created under the FSMA (2000), which was modelled on the PIAS and acted as the single compulsory ombudsman for retail complaints about financial products and services, operating under the rules and procedures laid down by the FSA. From January 2005, the FOS was extended to include general insurance as well.

2.4 Statutory Reporting

General insurers are required to submit annual returns to the FSA for statutory solvency monitoring purposes. They are required to prepare a standard form of

revenue account for the year; a balance sheet as at the end of the year; and a profit and loss account for the year with respect to each of its financial years. Further, an insurer's financial year must be for a 12 month period and subject to an external audit certification. The type of returns filed must also accord with the domicile status of the insurer as indicated in Table 2.5. Statutory returns are based on statutory accounting principles, which are balance-sheet oriented and emphasize the valuation of assets and liabilities on a 'liquidation' basis rather than on the 'going-concern' basis used for GAAP-based financial statements. These filings contain detailed information about various parameters such as distribution of assets held; provisions arising due to unearned premium; unexpired risks and outstanding claims; and information about reinsurance ceded and accepted. Techniques used for the annual valuation of the reported assets (e.g. mark-to-market accounting for quoted securities) also have to be in accordance with the asset valuation regulations set by the FSA. To prevent an over-reliance on any one asset class by an insurer, the extent of the admissibility of different asset types is also stipulated by the FSA. For example, some assets are shown in the FSA return at less than the market value shown in the shareholder accounts. Some assets have no 'admissible value' at all for FSA return purposes, for instance, investment gold.

On the other hand, technical provisions should be similar in both the shareholder accounts prepared under UK-GAAP and the FSA Return (General Insurance Manual, 2008). The regulations governing asset admissibility limit the options available to managers of the insurance companies in making discretionary investments. Thus, the approach used to calculate the technical provisions also becomes crucial from the regulatory perspective, lest the insurer should understate its liabilities. Daykin and Cresswell (2000) report that the FSA used a four pronged approach to ascertain the appropriateness of the technical provisions. First, it is the responsibility of the external auditor to confirm that the accounts are drawn in accordance with the GAAP/IFRS4. Second, specialist software is utilised by the FSA to conduct some preliminary analyses to ascertain the accuracy of the returns. Third, the Government Actuary's Department (GAD) may be called upon to conduct some detailed analyses in case there is uncertainty

regarding the adequacy of reserves. Finally, the FSA is authorised to ask the insurer to have a full-scale independent actuarial review of their technical provisions or overall balance sheet. However, current solvency regulations do not require the UK-based general insurance companies to have an appointed actuary or to take actuarial advice, although it is common for companies to consult actuaries.

Table 2.5: Return Type by Domicile of Insurers

Type of Company	Location of Head Office		
	United Kingdom	Non-UK EEA State	Rest of the World
Pure Reinsurer	Global return	Global return	Global return
UK-deposit Insurer			Global return and EEA branches return
EEA-deposit Insurer			UK branch return
All other Insurers	Global return	Exempt	Global return and UK branch return

Source: General Prudential Sourcebook: Insurers (FSA 2001/12)

The discounting of provisions for long tailed lines of business, such as liability insurance, is allowed under UK regulations, but the onus is on the insurer to demonstrate that accurate data and appropriate actuarial modelling techniques have been used for discounting (General Insurance Manual, 2008). It is also permitted that the technical provisions be set-up net of expected reinsurance recoveries. However, insurers are also required to simultaneously set up actuarially prudent bad debt provisions in case there is doubt about the recoverability of debts (e.g., reinsurance recoveries). Details of the most significant reinsurance exposures are also recorded in the annual statutory returns. An insurer's exposure to major treaty and facultative reinsurers must be disclosed, and in turn, reinsurers must disclose major cedants. Supplementary statements attached to Forms 9 to 15 and 17 of the statutory filings are used for making such disclosures. Major reinsurers and major cedants are defined as those exceeding certain premium ceded limits and certain debt plus anticipated recoveries limits

respectively (General Insurance Manual, 2008). For example, for proportional treaty reinsurance these are 2% of gross annual premiums, and for a non-proportional treaty, 5% of total non-proportional premiums written. The statement must show the name and address of the reinsurer or cedant, and the amount of any premium payable, debt of the reinsurer to the insurer and deposits received from the reinsurers. The extent of any connection between the parties must be shown.

2.5 UK's General Accounting Framework

One of the key events marking the evolution of an accounting framework for UK insurers has been the adoption of the European Insurance Accounts Directive (Council Directive - 91/674/EEC, 1991). Before the adoption of this directive, the accounts of a UK general insurance company were similar to those of other trading companies and included a balance sheet, general business revenue account, and a profit and loss account (General Insurance Manual, 2008). The 1991 Insurance Accounts Directive (IAD) proposed a pre-set format for financial reporting for the entire insurance industry, and also laid out rules regarding the valuation of assets and liabilities. Disclosures too had to be in accordance with the prescribed rules, which also provided for specific situations, for example the discounting of claims provisions. Daykin and Cresswell (2000, p. 5) also aver that "...assets are required to be valued at market value, or a proxy for market value where no ready market exists". This enabled different stakeholders viz., creditors, debtors and policyholders to compare the financial strength of insurers across the EU, thereby assisting in the development of the single internal market in financial services. Initially, the member states of the EU were given discretion in choosing alternative practices for asset valuation (fair value accounting or historical cost based accounting). However, the valuation became uniform all over the EU in the year 1999 with fair value accounting gaining prominence. Unlike other industries in which small and medium sized businesses (with an annual turnover less than or equal to £41million) are exempt from using the services of independent auditors, all the UK-based insurance companies have to get their annual report and accounts audited by independent auditors irrespective of their size.

Insurance Companies Accounts Regulations (SI1993/3246, 1993) under the purview of the Companies Act (1985) paved the way for the implementation of the IAD in the UK. Under these regulations, the old Schedule 9A CA 1985 was replaced by a new Schedule 9A, with effect for financial statements for financial years commencing on or after 23 December 1994 (General Insurance Manual, 2008). This new schedule, which closely followed the IAD and prescribed the form and content of the accounts of insurance companies and groups; was split in two parts dealing with individual annual accounts and consolidated annual accounts respectively. Further, the profit and loss account for general insurance companies was divided between technical and non-technical accounts. Under the IAD regime, member states were given an option to exempt some companies from preparing non-technical accounts (based on size); however, in the UK this option was not exercised. Under current accounting rules for UK non-life insurance companies, their technical accounts generally report the underwriting result akin to a trading account whereas the non-technical account contains information on profit and loss at the firm level (Daykin and Cresswell, 2000).

Another organisation that influences the financial reporting by insurance companies in the UK is the Association of British Insurers (ABI) through its publication called the Statement of Recommended Practice (SORP). Although not mandatory, these recommendations are generally followed by the UK insurance industry and are useful in explaining the confluence of the GAAP, the company law and wider regulatory environment. The ABI issued SORPs in 1990, 1998, 2003, and most recently in December 2005. The latest SORP recommended the use of an annual basis to determine underwriting results by general insurers with funded accounting being effectively prohibited¹⁴ (General Insurance Manual, 2008).

¹⁴ The annual and funded bases of accounting refer to the way profits are recognised by the insurers. The annual basis requires the profits and losses of business written during the financial year to be recognised at the end of that financial year by setting up provisions for outstanding claims, unearned premiums and unexpired risk provisions, and by deferring an appropriate portion of the acquisition costs. Under the funded basis, the recognition of profits (but not losses) is deferred for up to three years after the end of the financial year in which the business incepts.

While annual and funded bases are the only bases under UK GAAP for insurance accounting, there are also two methods of reporting the underwriting performance of a general insurance business for regulatory return or other statistical or management purposes – namely the accident year basis and the underwriting year basis. The accident year basis measures performance in relation to the events and earnings of a financial period, irrespective of when the relevant policies were incepted. The underwriting year basis measures performance in relation to the ultimate losses and premiums written in respect of policies incepting in the relevant financial period, irrespective of when the events (premiums, claims and expenses) occur (General Insurance Manual, 2008).

From January 1, 2005, all listed companies within the EU were required to adopt the International Financial Reporting Standards (IFRS) when preparing consolidated group accounts following the implementation of EU Regulation (1606/2002). Under this directive, non-listed insurance groups or individual insurance companies can voluntarily use IFRS standards when preparing consolidated or individual accounts. Currently, IFRS 4 issued in 2004 by the International Accounting Standards Board (IASB) is in force in the UK, which sets out the reporting requirements for insurance contracts. IFRS 4 applies to both, direct insurance and reinsurance contracts issued by an insurer, and to reinsurance contracts which it holds, and covers issues such as the accounting treatment of changes in reserves and disclosure. Moore, Drab, Christie and Shah (2004) suggest that IFRS 4 is the first step towards comprehensible and comparable financial statements underpinned by a single set of global accounting standards. However, the ABI SORP and UK GAAP remain relevant for the financial reporting of UK insurance companies as IFRS 4 requires insurers to continue to use the GAAP approvable in their Home State (General Insurance Manual, 2008). Sections 395 and 396 of the Companies Act (2006), along with Schedules 3 and 6 (part 3) to the Large and Medium Sized Companies and Groups (Accounts and Reports) Regulations - SI2008/410 (2008) prescribe the format for UK property-liability insurers' financial statements. These documents make insurers' financial statements compliant to UK GAAP. In addition, it is a legal requirement in the UK to follow the specific accounting format as laid out in these documents. Under existing UK insurance industry GAAP, insurers may continue to

report liabilities without discounting, but must continue to discount if that is the existing practice. Further, in the case of group companies, the same accounting standards should be followed for preparing the accounts of the parent and the subsidiary. However, if the insurer is using IFRS, UK company law allows an exemption from the UK GAAP. In light of the fact that the ABI SORP is based on UK company law, the accounts of UK-licensed insurance companies are likely to remain in the prescribed format until Phase II of the IASB's project sets a new standard (expected to be issued in 2014) for insurance accounting (General Insurance Manual, 2008).

2.6 Taxation

For regulatory purposes, insurance is classified as long-term (e.g., life) business and general (property-liability) business. Historically, companies transacting life insurance and various other types of investment and savings business were taxed on their investment income for the benefit of the policyholders and investors, and companies carrying on general insurance business on the balance of their profits. For composites, life insurance is treated as a separate business according to provisions made in section 431H (2) of the Income and Corporation Taxes Act (ICTA), 1988, which distinguishes between life insurance and other insurance businesses.

Before 1998, general insurers were taxed as any other company trading in the UK under the provisions of Case I of Schedule D of the ICTA88/S18, on the full amounts of profits and gains. In the absence of statutory guidance on computing the annual profit or gains of a trade, precedents from case law have formed the basis of taxation regime (General Insurance Manual, 2008). Cases addressing the relationship between the taxable and commercial profits have been instrumental in the establishment of the principle that the full annual profits or gains are to be determined by ordinary principles of commercial accounting, provided that there is no express statutory rule which requires otherwise. However, one important distinction between insurers and non-insurers is that FRS 12 (in respect of

provisioning) does not apply to the insurance contracts (General Insurance Manual, 2008).

Subsequently, general insurers were subject to the Finance Act (1998), section 42, with requirement that for Case I, the profits were to be computed “on an accounting basis which gives a true and fair view”. Later, section 42 of the Finance Act, 1998 was amended to incorporate the term ‘generally accepted accounting practice’ (GAAP), by section 103 of the Finance Act (2002), which also introduced a new section 836A into the Income and Corporation Taxes Act (1988) providing a definition of GAAP. However, the Income and Corporation Taxes Act (1988), section 836A too was subsequently repealed by the Finance Act (2005), which revised the legislation to deal with International Accounting Standards. The Financial Reporting Council (the UK’s independent financial reporting regulator) also made it clear that the ‘true and fair view’ remained a cornerstone of financial reporting in the UK and the companies adopting IFRS are also subject to this requirement. Thus, Case I principles apply to general insurance with some adaptations to the particular circumstances of insurance, for example, the non-taxable assessment of annual surplus emerging on mutual insurance business, and establishment of technical provisions under rules different from the generally applicable FRS 12 (General Insurance Manual, 2008). Thus, the taxation of general insurers is, with certain exceptions, largely dependent on the balance of their overall profit & loss account (taking into account both the underwriting and investment profit or loss) drawn in accordance with UK GAAP or IFRS 4 principles as discussed in section 2.4.

Despite the distinction in treatment of different organisational forms (viz. stock or mutual) under the tax system, the overall tax schedule for every type of UK insurance company is progressive (convex) with increasing annual reported income resulting in a higher marginal rate of taxation. This is an important feature in the context of this study, as taxation becomes one of the determinants of the purchase of reinsurance by insurers in the UK in the wake of a convex tax regime. In the same vein, Abdul-Kader, Adams and Mouratidis (2010, p. 496) explain that “...under a convex schedule, risk transfer via reinsurance enables insurers to reduce income volatility and lock into a certain level of future earnings that is taxed

more favourably than would otherwise be the case with risk retention". Similarly, Mayers and Smith (1990, p. 21) assert that "...since insurance firms typically face a significant probability of taxable income within the convex region, the purchase of reinsurance can reduce the firm's expected tax liability by reducing the volatility of pretax income". Thus, apart from risk management, reinsurance becomes a useful tool for tax management as well.

2.7 UK as an Environment within which to Conduct this Study

As mentioned in section 2.2 of this chapter, the UK's non-life insurance market is a large international insurance market. The amount of revenue generated and investments made by the insurers and reinsurers in the UK economy make the findings of this study potentially non-trivial for a number of stakeholders, viz., shareholders, managers and regulators. As is evident from the discussions presented in section 2.3 of this chapter, the regulation in the UK is targeted at maintaining the confidence of investors and protecting the contractual rights of the policyholder-customers. The insurance industry regulations have evolved to become more comprehensive with the implementation of a risk-principles based approach to solvency over the period of this study. However, regulation in the UK has remained a 'lighter touch' compared with the risk-based capital solvency requirements prevailing in the US. Therefore, the evolution of the UK's regulatory regime has not resulted in regulatory requirements intervening with the industry's capability to innovate and introduce new products in the market. The effect of this difference in regulatory approach could be interesting in terms of comparing the results of this study and US-focused research of a similar nature.

A unitary (homogenous) regulatory regime is another key institutional feature of the UK insurance market. This is in contrast to the US insurance market where regulation is the responsibility of the State-based regulators. Standards issued by the National Association of Insurance Commissioners (NAIC) are used in the US to coordinate regulation activity between the States. However, as these standards are not mandatory, there are some regulatory differences between the States. Moreover, the US-based insurers are subject to premium rate regulation, which is

not the case in the UK (Nelson, 2000). Thus, the premiums charged by the insurers in the UK's non-life insurance market are governed mainly by market forces (e.g., competition). These attributes of the UK's non-life insurance market facilitate potentially 'cleaner' tests of research questions put forward in this study.

As mentioned in section 2.5 earlier, accounting practices in the UK's non-life insurance sector have kept pace with changes in the regulations. Since 2005, non-life insurers in the UK are required to produce their annual accounts in accordance with the UK GAAP or IFRS 4, which intend to present a 'true and fair' view of the financial condition of the company. These set of accounts are also used for calculating the tax liability of the insurers. The 'fair value accounting' followed under the UK GAAP/IFRS 4 tries to value assets and liabilities at, or close to, their true market values; therefore it can induce volatility in the claim reserve, tax liability and capital adequacy calculations. The amount recoverable under a reinsurance treaty however, is independent of common valuation parameters (such as interest rates); hence, purchase of reinsurance can be instrumental in reducing the volatility induced by mark-to-market accounting. Moreover, the supply of reinsurance in the UK insurance market is not distorted by discrimination against foreign reinsurers as is the case in the US (Cole and McCullough, 2006). Browne and Ju (2009) report that the foreign reinsurers in the US are required to fully fund the claims arising in the current period and the reserves for future claims from US-cedants in the form of funds on deposit/trust accounts or a letter of credit. These requirements can distort the supply of reinsurance in the US insurance market, whereas the UK non-life insurance market is free of any such supply-side distortions. Furthermore, the extent of the reinsurance cover purchased is a free managerial decision in the UK non-life insurance sector, in contrast with some other jurisdictions, such as China, where the purchasing of reinsurance is mandatory. These regulatory features potentially make the results obtained in this study free of regulation induced biases.

Given the large number of players in the general insurance market competing for the same set of investors and customers, reinsurance can be a useful tool for signalling the financial health of an insurer, capacity building, and strategic capital and risk management. Given the size of the market; homogeneity of the

regulations; and independence of managers to purchase reinsurance from statutory requirements, the UK is considered to be ideal environment in which to conduct this study. Thus, reinsurance as a capital and risk management tool and its interaction with the cost of capital become important considerations for commercial as well as regulatory applications in the UK insurance market.

2.8 Conclusion

Insurance is an important and substantial part of the UK economy. Given its importance in respect of its social as well as economic impact, it is only inevitable that the UK insurance industry should be well regulated and solvent. The regulatory environment has changed over the time period covered by this study, from that of 'freedom with publicity' to a more 'principles-risk based' approach. This trend is likely to continue and regulations are likely to become less formulaic and more insurer-specific in future with the advent of Solvency II (in 2016). Maintaining a healthy solvency margin nevertheless remains the corner-stone of the UK's regulatory framework and statutory reporting plays a quintessential role in establishing that UK insurers are solvent and remain 'going concerns'. The use of reinsurance and the consideration of the cost of capital are therefore important in maintaining the future financial viability of general insurers in both the UK and elsewhere. This chapter also outlines the merits of the UK as an institutional environment for examining the link between reinsurance and the cost of capital. The theoretical context within which this study will be conducted is now explored in the next two chapters of this thesis.

CHAPTER 3. LITERATURE REVIEW

3.1 Introduction

Many theories have been put forward in the financial literature to explain the interaction between risk management and firm value (cost of equity). Chief among them are the expected-utility theory, the portfolio theory, the option pricing theory, the signalling theory, transaction cost economics, the agency theory and the theory of optimal capital structure. These theories utilise various frameworks and concepts, such as utility maximisation, risk aversion and the efficient market hypothesis, to establish how risk management can add to corporate value. Assumptions made by these theories vary considerably from one theory to another; hence there is a lack of consistency in explaining the nature of reinsurance markets. Moreover, these theories are also subject to the positive versus normative tension inherent in the rest of economics. In the context of this chapter, these theories will be used as positive-descriptive theories to characterise the risk management – firm value relation. However, the nature of descriptive and prescriptive theories is first described in section 3.2 below.

3.2 Positive – Descriptive Theories

Lipsey and Chrystal (2011) argue that the main aim of a theory is to either describe the way the world works or the way the world should work. If a theory tries to answer the first question, then it is called a positive-descriptive theory; otherwise it is described as a normative-prescriptive theory. Theories of the latter kind require value judgements, which invariably involve issues of personal opinion, hence cannot be settled by recourse to facts (Lipsey and Chrystal, 2011). Therefore, a researcher is unable to assess the validity of normative statements or theories without making a

value judgement. In words of Jensen (1983, p. 320) "...answers to the normative questions always depend on the choice of the criterion or the objective function which is a matter of values. Therefore normative propositions are never refutable by evidence". In contrast, positive theories attempt to describe the matters of fact, which may be actual or alleged. In the realm of positive theory, a researcher hypothesizes about some aspect of the behaviour of the world, which can be refuted if the evidence is found to support the contrary. Not only this, even if a positive theory involves a value judgement, it does not require invoking a value judgement to test it. These features of positive theory have made it an instrument of choice in the fields of scientific inquiry including economics and finance. Within the fields of economics/finance, the term 'positive' has been used to describe many aspects of a theory. For example, Coddington (1972) asserts that the term 'positivist' is a synonym for non-evaluative, non-metaphysical, non-hypothetical, non-speculative, testable, observable, operational, and predictive. These attributes bring studies in economics and finance closer in character to those in natural sciences. In the same vein, Keita (1997) reports that due to its relationship with positivism, scholars view contemporary economic research as qualifying for a cognitive status of being scientific.

Without knowing the way the world works, it is impossible to decide the best way for it to work. Hence, answers to positive questions are necessary inputs for informed normative judgements, such as policy decisions. On the other hand, opponents of the positive theory argue that choices made by researchers in respect of research question, environment, methodology and the objective function are value judgements; so a research study can never be absolutely positive. To counter this, proponents of positivism point out that the function relating the value of an objective function to the values of other variables in a model arises from positive theory. As Jensen (1983, p. 321) states "...while the choice of the objective or maximand ... is a value judgement and therefore a normative issue, knowledge of the valuation function itself (that is, the function that relates the value of the maximand to the values of the endogenous and exogenous variables) is a positive issue and requires a theory". Given these considerations, it is no surprise that the positive-descriptive school of thought has been employed extensively in the field of financial economics research. By the same

token, Smith (1986) adds that positive-descriptive thought has become the central theme of insurance and financial services (e.g., banking) research since the 1950s. The following is now a review of these positive-descriptive economic theories that have been applied to explain the effect of risk management on the financial condition of a firm.

3.3 Analysis of Positive-Descriptive Theories

The extant literature uses various models and frameworks to analyse and explain the corporate purchase of reinsurance. The risk exchange model, the capital asset pricing model (CAPM), the option pricing model and principal-agent models are chief amongst them. Key theories motivating these models are the expected utility theory, corporate finance theory and associated hypotheses/theories based on market imperfections. Each of these underlying frameworks is described in following sub-sections 3.3.1 to 3.3.7.

3.3.1 Expected Utility Theory

Developed by Von Neumann and Morgenstern (1953), the expected utility theory postulates that investors are risk-averse utility maximisers¹⁵. Investors' risk-aversion dictates the expected utility functions to be concave, and defines the decision rule under uncertainty as a trade-off between risk and return. More specifically, a risk-averse investor is expected to either maximise return at a given level of risk, or to minimise risk at a given level of return. Thus, the risk-return trade-off is an important feature of expected utility theory. Prior research has used risk-aversion as one of the fundamental factors to explain the purchase of insurance by individuals and corporates (e.g., see Schlesinger, 1981; Szpiro, 1985). Therefore, expected utility theory provides a conceptually useful basis to understand insurance markets. Studies attempting to explain the insurer-reinsurer relation using an expected utility framework treat insurers as risk-averse organisations searching for trading possibilities within the

¹⁵ Utility is a scale of measurement of the satisfaction derived from having monetary wealth.

insurance markets. The academic literature lists two basic approaches used to analyse reinsurance within the utility maximisation framework. According to Eden and Kahane (1988, p. 247), the first approach assumes that reinsurance exists as a loss-sharing arrangement between the insurer and reinsurer in ‘hierarchical chains’, while the second approach views reinsurance as part of a risk-sharing pool used to redistribute the risks underwritten. Assumptions implicit in both these views of the reinsurance is that all companies evaluate their portfolio using their respective utility functions and that the claims are normally distributed. Combining these assumptions with alternative approaches enumerated by Eden and Kahane’s (1988) optimal reinsurance arrangements (e.g., proportional or non-proportional) can be identified.

The seminal work on traditional actuarial models, which emphasises the risk pooling aspect of reinsurance markets, is attributed to Borch (1960; 1962). Assuming a Pareto-optimal allocation of risk, Borch (1962) showed that reinsurance can be seen as a risk-pooling arrangement where each company pays a share of each claim proportional to their risk tolerance. This model of insurance markets is known as the risk exchange model. According to the risk exchange model, insurance markets are envisioned as markets of ‘pure exchange’ comprising insurance companies looking to optimise their portfolio of insurance contracts via risk-sharing. In these markets, the risks underwritten by each firm are characterised by two elements. The first element, $F_j(x_j)$, represents the probability that the total amount of claims (L_j) contained in insurer j ’s portfolio will not exceed a certain threshold level x_j . The second element, S_j , denotes the funds available to the company to pay these claims. Hence, the expected utility, $U_j(S_j, F_j(x_j))$, of the insurance company ‘ j ’ can be mathematically represented as:

$$U_j(S_j, F_j(L_j)) = \int_0^{\infty} u_j(S_j - L_j) dF_j(L_j) \quad (3.1)$$

Before the risk sharing takes place, the company ‘ j ’ is liable to pay only for the claims arising from its own portfolio. The situation however will be different after the exchange of risk in the reinsurance markets, as risk-pooling will result in the redistribution of the liabilities of insurance companies. The reinsurance treaties arising

from the risk exchange within the pool of 'n' companies can be represented by a set of 'n' functions, where each function $y_j(x_1, x_2, \dots, x_n)$ is the amount to be paid by company 'j' if claims on respective portfolios amount to x_1, x_2, \dots, x_n . Since the combined liabilities of all the insurers remain unchanged, the following relation must hold:

$$\sum_{j=1}^n y_j(x_1, x_2, \dots, x_n) = \sum_{j=1}^n x_j \quad (3.2)$$

At the conclusion of these treaties, the utility function of each of these companies can be represented as:

$$U_j(\mathbf{y}) = \int_R u_j(S_j - y_j(\mathbf{x})) dF(\mathbf{x}) \quad (3.3)$$

$F(\mathbf{x})$ in equation 3.3 above represents the joint probability distribution of x_1, x_2, \dots, x_n ; and \mathbf{x} and \mathbf{y} denote the vectors $[x_1, \dots, x_n]$ and $[y_1(\mathbf{x}), \dots, y_n(\mathbf{x})]$ respectively. Assuming companies to be utility maximising rational agents, only the set of treaties which maximise the utility for all the insurers will be accepted. In other words, the set of treaties represented by vector \mathbf{y} will not be accepted if there exists, for all 'j', another set of treaties with a corresponding vector $\tilde{\mathbf{y}}$, such that

$$U_j(\mathbf{y}) \leq U_j(\tilde{\mathbf{y}}) \quad (3.4)$$

If there exists a set of treaties \mathbf{y} such that no alternative set $\tilde{\mathbf{y}}$ satisfying inequality (3.4) above can be found, then treaties in \mathbf{y} set are said to be 'Pareto-optimal'. Assuming utility functions to be of an exponential form, which represent constant absolute risk aversion, Borch (1962), Baton and Lemaire (1981), Lemaire and Quairiere (1986) amongst others conclude that proportional reinsurance is an optimal risk sharing arrangement. Under similar assumptions in conjunction with the assumption of hierarchical reinsurance markets, Gerber (1984) arrives at the same conclusion. However, these risk exchange models do have drawbacks, which must be described here.

The first drawback of expected utility based models is that they require the utility function of a specific form (e.g. exponential or quadratic) to be assumed for the decision maker. As Doherty (2000) explains, for expected utility theory to be applied, it is necessary to calculate the expected utility of the decision-maker according to the precise form of his/her utility function. In practice, however, the precise form of the utility function cannot be determined. Helten and Beck (1983) point out that risk exchange models fail to explain the frequent use of mixed coverage or non-proportional reinsurance arrangements. Eden and Kahane (1988, p. 249) question the assumption of risk aversion by arguing that "...diversified corporations with large numbers of shareholders must demonstrate risk neutrality: non-neutral utility considerations should not be employed, therefore, to explain the insurer-reinsurer interface". Doherty and Tinic (1981) add that expected utility-based arguments overlook the capital markets where the financial claims of insurers are traded. Garven (1987) further argues that expected utility theory does not take into account key environmental factors, such as the state of market competition and regulation. Schelsinger and Doherty (1985) also point that the expected utility framework ignores the interaction between different sources of risk. These shortcomings therefore prevent expected utility theory from providing a suitable explanation for capital structure and risk management decisions made by the corporations.

3.3.2 Portfolio Theory

Based on a set of simplifying assumptions about the behaviour of individual investors, Markowitz (1952), in his seminal work, derived the portfolio theory of risk. Like the expected utility theory, the portfolio theory also assumes investors to be rational and risk-averse utility maximisers. As Ryan (2007, p. 85) explains "...it is assumed that all investors are strictly rational in that they seek to maximise their own utility and have the ability to do so in a consistent and transitive way". Portfolio theory further assumes that markets are free of frictional costs, such as transaction costs and taxes. In markets characterised by these assumptions, rational investors hold numerous risky assets in pursuit of an efficient portfolio. According to Jensen and Smith (1984), a portfolio is said to be an efficient portfolio if it provides both the maximum expected

return for a given level of risk and minimum risk corresponding to an expected level of return. Based on these criteria, the risk reduction through diversification leads to an increase in the value of the portfolio.

The key insight of portfolio theory is that portfolio risk can be reduced by diversification. In words of Doherty (2000, p. 87) "...diversification it seems, helps us to avoid, or at least minimize, the probability of extreme outcomes. The same mechanism helps to explain how insurance functions and can be put to work to identify strategies for corporate risk management". According to the portfolio theory, an important property of risky assets is that they respond to changes in market conditions in ways which are statistically measurable (Ryan, 2007). Thus, within the framework of portfolio theory, statistical parameters, such as mean and variance, can be used to measure the return and risk of an investment. In this scenario, portfolio optimisation can be achieved through the trade-off of the mean and variance of the multivariate distribution arising from a combination of various risky assets in a well-diversified portfolio. These arguments suggest that managing portfolio risk is of paramount importance for individual investors, but do not explain the use risk management at the corporate level. Following is a discussion of corporate risk management from the perspective of portfolio theory.

Both the CAPM (Lintner, 1965; Sharpe, 1964) and Modigliani and Miller's (1958) work on the capital structure of a firm, are consistent with the portfolio theory. CAPM is widely used to estimate the corporate cost of capital (e.g. see Arnold and Hatzopoulos, 2000; Botosan, 2000), and is based on the idea that the market compensates only for the non-diversifiable market-wide risks as firm-specific (idiosyncratic) risks are diversified away by rational investors by constructing diversified portfolios. Under this paradigm, a firm's cost of equity (market value) is determined solely by the sensitivity of the firm's stock return to systematic risk (Poshakwale and Courtis, 2005). CAPM beta is the metric that captures the sensitivity of the firm's stock return to systematic risk within this framework. Similarly, the 'irrelevance proposition' of Modigliani and Miller (1958) states that capital structure and firm value are mutually independent, implying that capital structure does not have

any bearing on risk management. This is because firm-specific risks can be diversified away by the investors on their own account, and so risk reduction by the use of reinsurance is redundant. Using similar reasoning, Main (1982) suggests that risk management (reinsurance) can lead to a value reduction for shareholders due to the costs involved in risk management (reinsurance)-related transactions. These arguments therefore lead to the notion that risk management at best can be a zero NPV transaction with the scope for turning into a value-destroying negative NPV transaction.

There are however many exceptions to the predictions made by the portfolio theory. For example, studies such as Mayers and Smith (1990) and Main (1982) report that in practice, corporate insurance purchases are common, even amongst large and widely-held corporations. These observations point towards the limitations of portfolio theory in explaining the existence of reinsurance markets. An important limitation of the CAPM is that it overlooks the risk that the firm may become insolvent. Fairley (1979) argues that it is extremely difficult to treat the risk of insolvency within the framework of the CAPM. Insolvency risk however is an important predictor of the purchase of reinsurance by the insurers (e.g. see Browne and Hoyt, 1995; Mayers and Smith, 1990). According to O'Brien (2006), the management of idiosyncratic risks, such as through the use of reinsurance, is taken into account by business practitioners while valuing individual firms, as it can add value for shareholders by reducing uncertainty in future cash flows. Therefore, the inability of portfolio theory to account for important considerations in risk estimation and valuation render it inappropriate for analysing risk management through the use of reinsurance, and its impact on the cost of the equity of an insurer.

3.3.3 Option Pricing Theory

Insurance firms can be viewed as leveraged entities with the majority of their debt (liability) being raised in insurance markets through premiums paid by policyholder-customers (Hancock, Huber and Koch, 2001). Insurance policies used to raise this 'debt capital' have many option-like features, as the payments to policyholders are

contingent upon the occurrence of certain predefined events. Within the framework of option pricing theory, the value of these contingent claims can be modelled using five factors – the price of the underlying asset, the risk of the underlying asset, the risk-free rate of return, the exercise price, and the time to maturity (e.g., see Black and Scholes, 1973; Cox, Ross and Rubinstein, 1979; Merton, 1973). The key assumptions made by option pricing theory are that financial markets are arbitrage-free, frictionless and perfect. Due to its applicability to the pricing of most financial assets, option pricing theory finds its application in almost all areas of corporate finance (Cox et al., 1979; Weston and Copeland, 1992). Several researchers have implemented the option pricing model to insurance pricing (e.g. see Cummins, 1990, 1991; Doherty and Garven, 1986). Using the put-call parity condition of European type options¹⁶, Cummins (1990), and Cummins and Phillips (2000) have derived the following formula to estimate the insolvency risk of an insurer:

$$C(A, L, \tau) = A - [Le^{-r_f \tau} - P(A, L, \tau)] \quad (3.5)$$

In equation (3.5) above, A denotes the value of the insurer's assets; L is the value of the insurer's liabilities at the expiration date; r_f is the risk-free interest rate; $C(A, L, \tau)$ is the value of the call option on assets A at strike price L with time to expiry τ ; and $P(A, L, \tau)$ is the value of put option on assets A at strike price L with time to expiry τ . Thus, option pricing theory is capable of incorporating the insolvency risk in explaining the nature of the insurance markets. Indeed, Cummins and Sommer (1996) developed a model based on option pricing theory which predicts a positive relationship between insurer capital and insolvency risk.

Option theory enables inquiry into the insurance markets at the firm level as well. For instance, Black and Scholes (1973) posit that the equity of a levered firm can be viewed as a call option on the market value of the firm with strike price equal to the face value of the firm's liabilities. As long as the market value of the firm exceeds the liabilities, the equity of the firm is valuable to shareholders. However, if the liabilities exceed the market value of the firm, then the option expires out-of-money and the

¹⁶ A European type option can only be exercised at expiry date, whereas an American type option can be exercised at any time before expiry date.

ownership of the firm is transferred to the debtholders (policyholders) of the firm who are able to salvage only a proportion of their losses. This feature of the limited liability of equity is valuable to shareholders and is referred to as “the default put option” by Doherty (2000). Therefore the equity of an insurance firm can be valued by adding the value of this put option to the difference of market value of the firm and its liabilities (Doherty, 2000). On the other hand, the ‘fair price’ of insurance can also be obtained by subtracting the value of the shareholders’ default put option from the present value of policyholders’ losses. That is:

$$Le^{-rf\tau} - P(A, L, \tau) \quad (3.6)$$

The price calculated using equation (3.6) is consistent with the view of Hsieh, Chen and Ferris (1994), who argue that holding an insurance policy is similar to holding a put option written by the insurer. Further, Doherty (2000) contends that managing the value of the default put option held by shareholders lies at the heart of corporate risk management. Since the value of the default put option affects the value of the claims held by both the shareholders and the policyholders on the firm’s assets, a game ensues between these (rational) parties to ‘coerce’ the value of the default put option in their favour. As shown by equations (3.5) and (3.6) above, the value of the default put option is dependent on the value of the liabilities along with the value of assets and time to expiry of the option. As the value of liabilities increases, so does the risk associated with the firm’s earnings and the value of the default put option. This leads to an increase in the cost of the capital of the firm along with a decrease in the fair price of insurance policies issued by the firm. This may lead to a reduced market share and profitability of the insurer. Therefore, option pricing theory can provide useful insights into the nature of (re)insurance markets.

The options theory, however, is not a panacea. Rubinstein (1974) points out that application of the option pricing theory is limited to options with underlying assets that can consistently be valued with some degree of certainty. Unlike options written on tradable financial assets (e.g., shares), options with insurance contracts as underlying assets are not readily tradable in capital markets. Doherty (2000) suggests that due to the different distributional characteristics of return on insurance risks and other readily

tradable financial securities, the application of option pricing theory could be inappropriate in case of insurance markets. Due to these considerations, the application of option pricing theory in the context of the current study is deemed to be inappropriate.

3.3.4 Signalling Theory

Based on the notion of information asymmetry between insiders (managers) and outsiders (investors) the signalling theory posits that the former has more information than the latter (e.g. see Bhattacharya, 1979; Cornell and Shapiro, 1987; Ross, 1977). Due to various reasons, such as increasing the traded value of the firm and/or decreasing the cost of capital, managers have incentives to signal inside ('good news') information to other stakeholders, especially investors. Generally used instruments for signalling are dividend policy, capital structure mix and risk management policy (e.g., see Brennan, 1995; Talmor, 1981). While managers are eager to inform the market about any value enhancing positive news, they attempt to minimise the impact of any value destroying negative information along with protecting confidential proprietary information Botosan (2000).

The use of different instruments for signalling has given rise to various hypotheses based on signalling theory. From the perspective of the capital structure mix, Jensen's (1986) free cash flow hypothesis postulates that issuing debt can be used to mitigate agency problems and simultaneously signal the managerial confidence in the future earnings potential of the firm to meet its debt repayment obligations. In the same vein, Botosan (1997, 2000) avers that the effect of accounting (financial) disclosures on the cost of capital can be explained by signalling theory. Easley and O'Hara (2004) also propose that the improved quality of information disclosure reduces the cost of capital by 'levelling the playing field' for investors. Similarly, it has been reported in the literature that risk management tools, such as (re)insurance, are used by managers to signal firm quality (e.g. see DeMarzo and Duffie, 1995; Tufano, 1996). The reason why hedging can act as a signalling device is due to the fact that it

can reduce the effect of external forces, such as macroeconomic factors or natural catastrophes, on a firm's earnings, therefore enhancing the informational value of the financial statements prepared by the firm. As Doherty (2000) suggests, corporate risk management can reduce the volatility induced in earnings due to transient events, resulting in earnings estimates that reflect the true underlying value of the firm.

Campbell and Kracaw (1990) contend that risk management can be used to signal the surety of return to stakeholders other than shareholders, e.g. debt holders. It is an important consideration for insurers as their customers account for a very large proportion of their liabilities. Based on these arguments, Levy and Lazarovich-Porat (1995) suggest that signalling theory creates a link between observed management practices and financial theory, thus reducing the gap between the theory and practice. According to Paul (1992), signals that reduce uncertainty about a firm's ability to provide a given expected return on investment are more highly valued by investors. Wakker et al. (1997) contend that policyholder-customers are likely to pay higher premiums for policies issued by an insurer that has a higher probability of paying for incurred losses. Therefore, as reinsurance can improve the ability of an insurer to meet its liabilities, it can be used as a signalling device. As a result, signalling theory could provide a plausible explanation for the purchase of reinsurance by primary insurers.

Despite its appealing features, signalling theory has received some criticism in the financial literature. For example, Levy and Lazarovich-Porat (1995, p. 39) opine that "...it is difficult, if not impossible, to test signalling effects empirically". Brennan (1995) points out that the choice of objective function ascribed to insiders (managers) remains arbitrary within the framework of signalling theory. He further adds that signalling theory does not make clear why one signalling device or a combination of signalling devices is preferred over others. Nikolaev and Van Lent (2005) also caution against the susceptibility of signalling theory based hypotheses to endogeneity amongst variables and sample selection bias. In line with the assertion made by Puelz (1992), that signalling theory finds limited application in empirical research, this framework is thus deemed unsuitable to be used in the context of the present study.

3.3.5 *Transaction Cost Economics*

Williamson (2005, p. 41) defines Transaction Cost Economics (TCE) as “...an effort to better understand complex economic organization by selectively joining law, economics, and organization theory”. He further elaborates that by employing discrete structural analysis, TCE describes firms as governance structures, which are concerned with the allocation of economic activity across alternative modes of organisation (markets, firms, bureaus, etc.). The choice of these governance structures in a firm are dictated by three behavioural characteristics of the firm’s stakeholders - bounded rationality, opportunism, and risk neutrality¹⁷ (Chiles and McMackin, 1996). According to Blair and Kaserman (1983), transaction costs are dependent on the interaction between bounded rationality, opportunism and transaction specific factors (e.g., asset specificity). Many scholars argue that there exist multiple governance structures to organise economic transactions (e.g. see Williamson, 1979). These structures include many hybrid intermediate modes within the extremes of centralised hierarchies and fragmented individual market contracting-based structures. Shelanski and Klein (1995) argue that the main tenet of the TCE is that managers and other stakeholders strive to align contractual relationships with the adopted governance structure so as to minimize the costs of transacting business. They further add that due to TCE’s applicability to a wide range of transactions, it finds application in numerous fields, viz. corporate finance, marketing, regulation, amongst others.

Reinsurance is essentially a financial contract that provides the insurer with contingent post-loss finance (Mayers and Smith, 1990). Froot (2007) states that the benefits and costs of a corporation holding risk underpin most of the financial policy decisions. Similarly, Grillet (1992) argues that risk management decisions could be perceived as integral components of the capital structure optimisation process because a firm can increase its debt capacity by reducing the costs of financial

¹⁷ Limitations arising due to inability of the rational economic agents in defining, describing, or pre-specifying responses to all future contingencies lead to bounded rationality (e.g. see Hart, 1995). Williamson (1979, p. 41) defines opportunism as “...a variety of self-interest seeking but extends simple self-interest seeking to include self-interest seeking with guile”.

distress through risk management. In the case of the insurance industry, transacting reinsurance is simultaneously a capital structure as well as a risk management decision, which can be analysed using the TCE framework. By the same token, Bjuggren (1995) analyses the nexus between capital structure, costs of financial distress and insurance and concludes that the degree of asset specificity may be the motivating factor for corporate purchase of insurance. Since reinsurance redistributes the risks underwritten by the insurers, it can be viewed as a mechanism for improving the efficiency of governance structures within the domain of the insurance industry. Moreover, by providing advisory services to cedants especially in the case of unique risks, reinsurers can improve the pricing technology used by the insurers. Further, the monitoring of insurance company managers by reinsurers can lead to a reduction in the agency costs between managers and investors. In the same vein, Skogh (1991) states that external monitoring by insurers inhibits the opportunistic behaviour by managers of the insured entity.

Despite its conceptual appeal, a few major limitations of TCE have been reported in the academic literature. Due its limited economic view of individual and firm behaviour, TCE neglects some important factors involved in the corporate insurance purchasing decision, such as the risk reduction effects of business diversification and the regulatory status of the firms (Speklé, 2001). The key variables required in any TCE based study, (viz. the uncertainty and frequency of loss events), are difficult to measure consistently across firms and so a TCE framework is not easily applicable to empirical research (Shelanski and Klein, 1995). Moreover, Williamson (1988, p. 589) points out that "...by contrast with the formal modelling apparatus associated with much of the financial economics literature, the transaction-cost economics approach to corporate governance and corporate finance is of a relatively preformal kind". Uncertainties regarding the importance of transaction costs in influencing corporate risk management decisions such as insurance, leave substantial scope for more precise analysis (Main, 2000). These limitations thus rule out the use of TCE in the context of the current study.

3.3.6 Agency Theory

Like TCE, agency theory assumes economic agents to be risk-averse and self-interested utility maximisers governed by bounded rationality (Eisenhardt, 1989). Agency theory further assumes that the relationships between different groups of economic agents, such as investors (principals) and managers (agents), are established through contracts (Baiman, 1990). Due to the separation of ownership from operational control, there is potential for information asymmetry which leads to contracting problems of adverse selection and moral hazard (Jensen and Meckling, 1976)¹⁸. This could lead to inefficient contracts that allow agents to take decisions that are not perfectly aligned with principals' interests. Therefore, the key tenet of agency theory is that "...the principal-agent relationships should reflect efficient organization of information and risk bearing costs" (Eisenhardt, 1989, p. 59).

In agency theory, there are two key agency relationships; first, between owners and managers, and second between debtholders and owners. Scordis and Porat (1998) suggest different utility functions for principals and agents as the key reason for the divergence of interests of owners and managers. Tihanyi and Ellstrand (1998) add that due to the inability of managers to diversify their employment risk, they may have a different attitude to risk compared with shareholders. Similarly, Eisenhardt (1989) suggests that agency problems between managers, owners, and creditors can arise from differences in the nature of their economic claims. For instance, in the case of a leveraged firm with efficient executive compensation contracts, managers may take financing and/or investment decisions that favour equityholders at the expense of debtholders. As Doherty (2000) asserts, managers/owners can use asset substitution and/or underinvestment to reduce debtholders' utility. Thus, to control the opportunistic behaviour of cooperating groups, contracting constituents use monitoring (e.g., audits) and contracts to protect their respective economic interests. In the case of insurance companies, the agency relationship between managers,

¹⁸ Adverse selection in this context arises from incomplete information available to the owners/investors when appointing managers for the insurance company. Thus, adverse selection can result in the appointment of manager(s) whose interests are not perfectly aligned with those of the owners. This can give rise to the problem of moral hazard as managers can take imprudent risks which are detrimental to the firm-value.

owners and debtholders is made more complex by the fact that the majority of their debtholders are also their customers. Insurance policyholders are the vulnerable group in this arrangement due to their inability to diversify the insured risk over many insurers (Froot, 2007). Regulators in this context can be seen as the monitors who protect the interests of the policyholder-customers against their disadvantage. Regulation, however, imposes some costs (e.g. regulatory reporting) on the insurers, which are likely to be passed on to the customers, thus increasing the cost of insurance. Further, regulation is unlikely to alleviate completely agency incentive conflicts between owners and the managers. Nevertheless, reinsurance can provide surety of claim payments to policyholders, and monitor the activities of insurance company managers to minimise the risk of asset substitution and/or underinvestment.

Proponents of agency theory point out that hypotheses postulated using agency theory based constructs are empirically testable (e.g. see Eisenhardt, 1989). Moreover, they have been successful in explaining the corporate purchase of insurance (e.g. see MacMinn, 1987; Mayers and Smith, 1981, 1982, 1987; Zou, 2010; Zou and Adams, 2008). Garven and MacMinn (1993) argue that the corporate purchase of insurance reduces the severity of asset substitution and underinvestment problems, which in turn reduces their market cost of capital¹⁹. Grillet (1992) contends that by providing post-loss job security to managers, insurance can lower the agency conflicts between managers and owners. Further, Han (1996) adds that corporate insurance can facilitate efficient incentive compensation that aligns the interests of managers with that of the owners. These analyses based on agency theory have led to various hypotheses that have been empirically tested by several studies (e.g. Core,

¹⁹ The underinvestment problem is likely to arise when a highly levered insurance firm suffers unexpectedly severe losses. In such circumstances, shareholders may be motivated to exercise their default put option under limited liability rules and 'walk away' from the firm leaving policyholders with unrecoverable losses (i.e., the so-called 'debt over-hang' effect). However, reinsurance can help mitigate the underinvestment incentive by providing post-loss financing for the assets destroyed/impaired by catastrophe (e.g., see Garven and MacMinn, 1993). Reinsurance can also control the asset substitution problem whereby the shareholders/managers of insurance firms may seek to increase asset risk after writing policies with (fixed claimant) policyholders (e.g., see Jensen and Meckling, 1976). For example, ex-post asset risk shifting (and other moral hazard effects) can be controlled by the terms and conditions of reinsurance policies as well as the monitoring and auditing activities of reinsurance companies (e.g., see Doherty and Smetters, 2005).

1997; Hoyt and Khang, 2000; Mayers and Smith, 1990). Despite its appealing features, such as the ability to facilitate empirical research, agency theory has not been without its critics. For example, Nilakant and Rao (1994) suggest that human attributes of trust and fairness in business relationships are overlooked by agency theory. Baiman (1990) argues that principal-agent models are highly stylised and simplified. Leland (1998) also points out that the asset substitution problem does lead to agency costs, but their importance is rather small in comparison to the other determinants (e.g., leverage) of capital structure and risk management choices made by the firm. In view of these limitations of agency theory, it is unsuitable to be used as the framework for the current study.

3.3.7 Theory of Optimal Capital Structure

As noted earlier in sub-section 3.2.2, Modigliani and Miller's (1958) seminal work establishes that in efficient markets with symmetric information, the value of the firm is independent of its capital structure. Implicit in this view of the financial markets are assumptions that debt can be raised at a risk-free rate, no agency costs exist, and that investment and financing decisions are independent of each other (that is, investment decisions precede the financing decisions, rather than being taken simultaneously). Under these perfect market conditions, risk management has no value-enhancing effect on shareholders' wealth, as in efficient markets shareholders can diversify risks by holding diversified portfolios of investments. However, relaxing the assumption of efficient markets reveals that capital structure decisions do have a bearing on the risk management strategies and on the value of the firm and vice versa (e.g. see Jensen and Meckling, 1976; Grossman and Hart, 1982; Dewatripont and Tirole, 1994; Leland, 1998). In the same vein Froot (2007, p. 273) asserts that "...most financial policy decisions, whether they concern capital structure, dividends, capital allocation, capital budgeting, or investment and hedging policies, revolve around the benefits and costs of a corporation holding risk". Therefore, it is necessary to include various frictional costs in any credible model attempting to explain the observed capital structure of firms.

Using a different combination of frictional costs, various models study the interaction amongst the key variables that determine the capital structure of a firm. For instance, Kraus and Litzenberger's (1973) model focuses on the tax-advantage/bankruptcy costs trade-off, whereas Jensen and Meckling (1976) concentrate on the agency costs of debt. The research on optimal capital structure has, over the years, gravitated towards two prominent classes of models, namely, trade-off models and pecking order models. As the name suggests, the key tenet of trade-off theory based models is that in imperfect markets the benefits of increased leverage are associated with some costs, and the optimal capital structure balances these costs and benefits (e.g., see Titman, 1984). Models considering single-period cost-benefit choices of capital structure are known as static trade-off models, whereas models considering multi-period cost-benefit trade-offs are termed as dynamic models. Pecking order theory on the other hand assumes that (cheaper) internal sources of finance are preferred by managers over (more costly) external sources for funding new investments. This 'pecking order' of sources of finance arises due to information asymmetries between managers and investors (Myers and Majluf, 1984). Irrespective of the differences between the trade-off theory and the pecking-order theory, they are both capable of analysing a wide array of environments and variables. For instance, parameters related to bankruptcy costs, financial distress costs and agency costs, which lead to the existence of optimal capital structure, can all be accounted for within the optimal capital structure framework. This versatility imparts conceptual appeal to the optimal capital structure framework.

If viewed as stand-alone models, the trade-off theory and the pecking order theory both have certain limitations. For example, static trade-off models consider financing and investment decisions to be independent of each other (Fischer, Heinkel and Zechner, 1989). Shyam-Sunder and Myers (1999) show that static trade-off models have low explanatory power in explaining the variation in the capital structures of firms over time. On the other hand, Frank and Goyal (2003) provide evidence that pecking order theory is not robust to the inclusion of conventional leverage factors in empirical models. However, collectively these models are capable of identifying and incorporating important determinants of capital structure. Accordingly, it is considered

that on balance, the theory of optimal capital structure provides the most appropriate and viable framework to facilitate the empirical inquiry proposed in this study.

3.4 Conclusion

The main positive-descriptive theories relevant to this study have been reviewed in this chapter. Positive-descriptive theories are chosen because they provide the most credible and compatible framework to analyse the effects of the purchase of reinsurance on the cost of the equity of non-life insurers.

The theory of optimal capital structure is adjudged to be the most appropriate framework for the present study. This is because it is capable of incorporating various frictional costs arising due to market imperfections into analyses. Moreover, the optimal capital structure framework incorporates the idea that capital structure and risk management decisions are co-determined. This is an important feature in the context of this study as reinsurance is essentially a risk management mechanism. Further, numerous studies have suggested that risk management (reinsurance) can lower the frictional costs arising due to market imperfections. These studies provide a useful benchmark to compare and evaluate the results obtained in this study of UK non-life insurers. The major classes of the theory of optimal capital structure and their ability to further analyse the reinsurance-cost of equity relation are further examined in the next chapter of this thesis.

CHAPTER 4. HYPOTHESES DEVELOPMENT

4.1 Introduction

Based on the theoretical and empirical literature reviewed in Chapter 3, this chapter develops two main testable hypotheses that will be tested empirically in subsequent chapters. The present chapter discusses the theory of optimal capital structure and the role of risk management in the context of the financing and investment policy of a firm. This analysis identifies the necessary conditions that make risk management a value-added activity. Following this, the value creation process in the insurance industry is discussed, leading to an exposition of the interaction between the value creation process and reinsurance. This provides the context within which to examine further the relation between reinsurance and the cost of equity capital in the UK's non-life insurance market.

4.2 Optimal Capital Structure

Under Modigliani and Miller's (1958) irrelevance proposition, the value of the firm is dependent only on its investing decisions and is not affected by its cost of capital. Subsequent work by Modigliani and Miller (1963) incorporates market frictions, such as taxes, into their analysis. As a result of such imperfections, some costs such as contracting costs, and bankruptcy costs become embedded within markets, which in turn results in an increase in the costs of external financing. This rationale implies that given market imperfections, there exists an optimal capital structure for each firm. The concept of optimal capital structure has since been synthesized and analysed in numerous academic studies, giving rise to two prominent theories of capital structure, namely – the trade-off theory and the pecking order theory. Both of these theories are explained in the following sub-sections 4.2.1 and 4.2.2.

4.2.1 Trade-off Theory

The static trade-off theory of capital structure is based on the idea that for an optimal capital structure of a firm to exist, it is necessary for certain market imperfections to prevail and be reflected in the capital structure choices made by the firm. For example, under the assumptions of static trade-off theory, optimal capital structure arises as a consequence of the actions of firms striving to balance the benefits of a leveraged capital structure (e.g., tax shield advantages) against the costs arising from leverage (e.g., increased bankruptcy risk). As Bradley, Jarrell and Kim (1984, p. 857) explain "...the optimal capital structure involves balancing the tax advantage of debt against the present value of bankruptcy costs". Many studies (e.g., Kraus and Litzenberger, 1973; Scott, 1976; Titman, 1984) exploring the capital structure optimisation process through trade-offs between tax advantages and bankruptcy costs imply that this process affects the value of a firm through multiple channels. This is because, apart from bankruptcy costs, agency costs of debt and the loss of non-debt tax shields have also been linked to high leverage. For example, enhanced agency costs of debt may arise in the case of a highly levered firm if the managers, on behalf of shareholders, dilute the 'quality' of productive assets by investing in overly risky projects that undermine the ability of the firm to service its debt obligations (i.e., the so-called asset substitution problem). In the same vein, Ryan (2007, p. 209) lists three key variables, namely, the cost of equity, tax, and the default premium, through which leverage can affect the traded value of a firm. However, the validity of the relation between these variables and capital structure is an empirical issue that needs to be tested. Moreover, the empirical results reported in the financial literature do not uniformly support the static trade-off model. For example, Graham, Lemmon and Schallheim (1998) find that firms with higher marginal tax rates have higher leverage than firms with lower marginal tax rates, whereas Hovakimian, Kayhan and Titman (2012) report that higher marginal tax rates correspond to lower debt ratios in their sample drawn from the US corporate sector.

However, the limitations with static trade-off models are that they assume the financing and investment decisions of a firm to be single period (hence static) choices and exogenous to each other. Such limitations can be overcome by using dynamic trade-off models of optimal capital structure which take into account not

only the present costs and benefits, but also the expected future costs and benefits of adjusting capital structure. The findings of Hovakimian et al. (2012) are consistent with the predictions of dynamic trade-off models presented in Fischer et al. (1989), and Leland (1994). This implies that recapitalisation costs are high in comparison with costs of single-period optimal capitalisation. To capture the effect of recapitalisation costs, transaction costs are incorporated in dynamic trade-off models along with bankruptcy costs. However, the assumptions made by different versions of dynamic trade-off models vary from model to model. Some models assume investment decisions to be independent of financing decisions (e.g., Goldstein, Ju and Leland, 2001; Strebulaev, 2007) whereas others assume them to be co-determined (e.g., Hennessy and Whited, 2005; Titman and Tsyplakov, 2007). Models treating financing and investment policies of the firm as co-determined conclude that the optimal capital structure of a given firm is path dependent²⁰ (e.g., Hennessy and Whited, 2005). Aside from this finding, dynamic models have significantly contributed to the identification of parameters and processes governing the choice of optimal capital structure such as current and expected profits, retained earnings and the mean reversion of leverage (e.g., see Frank and Goyal, 2007). Retained earnings and leverage also are important considerations in the pecking order theory of capital structure that is outlined below in sub-section 4.2.2.

4.2.2 Pecking Order Theory

According to the 'pecking order theory' put forward by Myers (1984), firms prefer internal rather than external sources of finance for funding new investments. The theory postulates that amongst the sources of external finance, debt is preferred over equity. Myers and Majluf (1984) explain that such a ranking of capital sources arises due to the information asymmetries between managers and investors in the firm. The result of such information asymmetry problems is that managers attempt to issue financial securities when they believe that a firm's assets are overvalued by the market, but the price of the security falls on such announcements as investors anticipate a lack of complete information on the firm's prospects. Since

²⁰ Hennessy and Whited (2005) explain that since current financing choices of a firm are determined by the firm's (financial) history, optimal financing policy (capital structure) is path dependent.

managers are aware of this sub-optimal financing situation, they could forgo some value-enhancing positive NPV projects. Such an argument leads to the 'pecking order' of different financing mechanisms, which, in turn follows the ascending order of adverse selection costs incurred using alternative means of financing in the presence of information asymmetry problems in financial markets.

However, the mechanism explained above is not the only one that gives rise to a 'pecking order', as the transaction costs associated with different sources of finance may also lead to a preference ranking of alternative sources of capital. Therefore, information asymmetry is at best a sufficient, but not a necessary condition for a financing 'pecking order' to exist. Indeed, this ambiguity in explaining observed financing patterns of corporate financing is evident in empirical research that has tested the explanatory power of this theory. For example, in the US corporate sector, Shyam-Sunder and Myers (1999) find that the pecking order theory has good explanatory power, whereas Frank and Goyal (2003) provide contrary evidence. To remedy this shortcoming, some authors have used modified versions of the pecking order theory which incorporate financial distress costs (e.g., Lemmon and Zender, 2010) in their empirical examinations. However, this treatment does not necessarily result in unambiguous evidence in support of the pecking order theory – for example, Fama and French (2005) provide results that contradict the confirmatory conclusions of Lemmon and Zender (2010).

Agency costs have also been suggested in the literature as a possible cause for the existence of the pecking order. In their seminal work, Jensen and Meckling (1976) argue that managers, being self-interested agents, pursue private benefits, such as job security and perquisite consumption, which gives rise to agency problems between shareholders and the management. They further point out that debt holders have priority over a firm's assets in the event of financial distress, and as such, there is the potential for another set of agency conflicts to arise between shareholders and creditors of the firm. Under these conditions, shareholders have an incentive to invest in highly risky assets (a process called 'risk-shifting'), at the expense of the creditors to the firm and solutions to these agency incentive conflicts, such as performance based compensation and/or debt covenants are expensive to set-up and so add to agency costs. Attempts by the firm to balance

different types of agency costs can thus lead to a pecking order of financing, identical to the one described above. Agency costs may thus be used to explain the pecking order of different sources of finance. However, Myers (2003) cautions that this explanation works well in the case of small companies with substantial share holdings of managers and employees, but not for large widely held corporations, as their employees and managers generally hold a very small fraction of the total firm value. Nevertheless, agency costs are useful for explaining the existence of optimal capital structure. Indeed, Leary and Roberts (2010, p. 333) state that "...we find a marked increase in pecking order behaviour as the potential for agency conflicts increases. Moving from firms likely facing low agency costs to those facing high agency costs corresponds to an average increase in predictive accuracy of almost 20 percentage points".

Irrespective of the on-going debates over the validity of various theories of capital structure, the objective here is to identify the variables that might give rise to the optimal capital structure. The analysis presented above has pointed out that costs arising due to market imperfections are the key drivers of managers' efforts to achieve optimal capital structure. The key costs identified are the cost of financial distress, bankruptcy costs, agency costs and transaction costs. Therefore, a technique that allows firms to optimise on these costs and minimise the costs of external sources of finance can be valuable to the firm. It is in this regard that risk management can add value to the firm. This is now being discussed in the next section 4.3.

4.3 Risk Management and Value Creation

In their influential work on the modern theory of corporate risk management, Mayers and Smith (1982) argue that risk management can add value to a firm if it allows them to mitigate some of the frictional costs arising in imperfect markets. As mentioned previously in section 4.2, a firm facing increased frictional costs, such as the costs of financial distress, is more likely to incur agency problems leading to sub-optimal investment decisions. Therefore, it follows that prudent risk management can mitigate these problems by reducing the cost of external finance, and the potential for agency incentive conflicts thus promoting investments in

value enhancing projects. In the same vein, Doherty (2000, p. 9) adds that "...hedging complements other sources of financing, internal and external, to replace destroyed assets and new investments". Such reasoning has given rise to a sizable body of literature that links corporate financing decisions to risk management (e.g., see DeMarzo and Duffie, 1995; Froot, 2007; Froot, Scharfstein and Stein, 1993). However, business risks can vary between different firms and across industrial sectors. Therefore, to explain the value added by risk management at the firm level, it is imperative that the value creation process of concerned industry is well understood. To facilitate this exposition, the value creation process in the insurance industry is now discussed below.

The mechanism by which insurers create value is well explained in Hancock, Huber and Koch (2001, p. 8), which has been reproduced succinctly here. They suggest that an insurance company can be likened to a leveraged investment fund that generates funds (debt) through insurance markets (instead of capital markets) by selling insurance policies (instead of issuing bonds) and invests them in financial assets in accordance with statutory and regulatory requirements. This structure spells competitive advantages as well as disadvantages for the insurance industry. In comparison to other investment funds, non-life insurers are potentially at a disadvantage on the investment front for two main reasons: first, double taxation is imposed on the shareholders (corporate tax on insurers' earnings as well as personal tax on any dividend income); and second, limitations imposed by the regulators on investment portfolio allocation decisions. In contrast, the scenario is invariably different on the fund generation side and thus a potential source of value added by the insurance industry. Doherty and Tinic (1981) observe that insured parties by definition are risk-averse and unable to diversify away the risk they are endowed with at the market rates in the capital markets. As a result, insurers are able to charge premiums above their actuarially fair values, i.e., at a price higher than their economic/production costs and one that includes loadings for insurers' profits and reserve margins. Policyholder customers are willing to pay this price as long as it is below the utility they attribute to insurable assets. It thus follows that insurers are able to 'borrow' loss contingent capital from insurance markets at favourable rates in comparison to raising finance on the capital markets (Froot, 2008). This mitigates the disadvantages faced by insurers

on the investment front. Therefore, efficiently managing and pricing the risk inherent in the contingent claims sold in the insurance markets forms the core function of the insurance business. This reasoning further implies that, prudent risk management is the 'bed-rock' on which insurance industry is built. The rest of the chapter elaborates upon this statement and advances two principal hypotheses to be tested in this study.

4.4 Reinsurance and the Cost of Equity

Based on the arguments made earlier in section 4.3, one can conclude that reinsurance can add value only if it enables insurance companies to optimise on the frictional costs arising due to market imperfections. However, this view understates the utility of reinsurance as it is intrinsically different from other financial hedges (e.g. derivative instruments) in at least four key regards. To understand how the first difference arises, one needs to first define a financial hedge in the context of a non-financial firm. For instance, Nance, Smith and Smithson (1993, p. 267) define corporate hedging as, "...the use of off-balance-sheet instruments – forwards, futures, swaps, and options – to reduce the volatility of firm value". Reinsurance on the other hand is well accounted for in the financial statements submitted to the regulator by an insurer, with the claims recoverable from the reinsurers being counted as one of the admissible assets used in calculating the capital adequacy requirements of insurers. Therefore, reinsurance is a hedge instrument that is well-integrated with the capital structure of an insurer rather than an off-balance sheet item. The second reason that makes reinsurance different from the financial risk hedging is the fact that since reinsurance involves the transfer of 'pure downside risks' it is a pure hedge (indemnity) instrument which cannot be used for speculative purposes (Aunon-Nerin and Ehling, 2008). Moreover, Campello, Lin, Ma and Zou (2011) note that some firms may opt out of their hedging positions once they have secured sufficient capital from lenders; however, this option is not possible with reinsurance. This gives rise to the third difference between reinsurance and other financial hedges as once agreed, the reinsurance contract (treaty) is legally binding both on the primary insurer (the cedant) and the reinsurer. Fourth, reinsurance treaties often provide ancillary

advisory services, such as the pricing of emerging or unusual risks, and/or claims handling. These 'real services' can provide added-value for the shareholders and policyholders of insurance firms. Given these differences, reinsurance can be valuable to insurance companies, not only by reducing the cost of external finance, but also in other respects. These are described further in sub-sections 4.4.1 and 4.4.2 below.

4.4.1 Decision to Reinsure

Krvavych and Sherris (2006) assert that frictional costs (e.g., taxes) mean that the shareholder value is more likely to be enhanced by managing underwriting risks than by creating value from managing investment portfolios. Harrington and Niehaus (2003, p. 125) define underwriting risk as "...the risk that prices and reported claim liabilities will be inadequate as compared to realized claim costs". In other words, the underwriting risk is effectively the result of the interplay between estimated claim costs and the uncertainty in their estimation. Since policyholder-customers of an insurance company are also its major capital providers (creditors), the management of underwriting risk is also important from a strategic product-market perspective. By the same token, Froot (2007) suggests that insurers and reinsurers are not only subject to the investment risk, but also to the product market imperfections arising due to the inability of policyholder-customers to efficiently diversify insurable risk. This reasoning implies that exposure to financial distress will subject an insurer to reduced new business growth and hence loss of profitability, as well as increase in the market cost of capital. Evidence provided by Wakker et al. (1997) and Merton (1993) suggests that policyholder-customers deeply (and disproportionately) discount the premium for an insurance policy issued by an insurer with an increased probability of default (ruin). Doherty and Tinic (1981) further demonstrate that the cost of capital of insurance firms can be reduced by purchasing reinsurance and their traded value is increased because policyholders are willing to pay higher premiums for enhanced financial strength. This proposition is consistent with empirical results from the US property-liability insurance industry reported in Sommer (1996)²¹. Froot (2008) also notes that

²¹ Garven and Lamm-Tennant (2003) point out that the frequency, severity and timing of claims settlement can vary between lines of insurance business. For example, property

reinsurance is important because compared with investors the policyholder-customers of insurance companies are less efficient at diversifying risk, and that reinsurance provides such fixed financial claimants with the certainty of indemnification in the event of an insured loss. Reducing the probability of ruin through reinsurance could also enable direct insurers to create value for their shareholders by increasing their underwriting capacity (Adams, 1996; Blazenko, 1986), and reducing current and expected taxes (Abdul-Kader et al., 2010; Adams et al., 2008; Garven and Loubergé, 1996). In this sense, determining the decision to reinsure can also be viewed as a financing (capital structure) choice decision (Garven and Lamm-Tennant, 2003; Hoerger et al., 1990). The foregoing analysis therefore implies that:

H1: Other things being equal, insurers using reinsurance have a lower cost of equity than non-users.

4.4.2 Extent of Reinsurance

Sung (1997) reports that the mispricing of assumed risks by primary insurance writers can result in a sub-optimally diversified risk pool as well as engender increased agency costs and other market failure problems (e.g., increased risks associated with moral hazard and bankruptcy). Likewise, Doherty and Lamm-Tennant (2009, p. 57) contend that "...it makes sense for primary insurers to retain the primary or "working" layers of the risks they underwrite, while passing the "tail risks" or excessive geographical or product concentrations to reinsurers." Hence reinsurance can be an important risk management mechanism for improving the risk bearing capacity of primary insurers (Mayers and Smith, 1990; Adams, 1996).

claims are usually settled within a short timeframe, while liability (tort) claims can take several years to resolve. This means that insurers with insurance lines with longer claims delays and/or potentially severe losses are expected to benefit from holding onto their invested funds for a longer time than insurance firms that have lines of business with shorter settlement periods and/or generally smaller claims. However, because of the uncertainty relating to the timing and quantum of losses in long-tail lines, and the associated enhanced probability of ruin, the amount of reinsurance purchased is likely to be greater in insurance companies that have significant long-tail business than in insurers with short-tail lines and more predictable claims. Hence, the reinsurance-cost of capital relation could be influenced by the line of business. Additionally, Garven and Lamm-Tennant (2003) contend that the demand for reinsurance is expected to be greater, the lower the correlation between insurers' returns on their investment portfolios and higher costs of claims. That is, reinsurance mitigates the risk (costs) of financial distress/bankruptcy.

Recent advances in finance theory explicitly recognise that frictional costs and other market imperfections (e.g., taxes) are important factors motivating the purchase of reinsurance (Mayers and Smith, 1990). Froot et al. (1993) provide a framework for analysing risk management decisions in terms of market frictions and the impact of financing policy on firms' investment decisions. They argue that cash flow volatility can be costly for shareholders and that by stabilising cash flows following unexpected shock events, risk management techniques (reinsurance) enhances the value of (insurance) firms by enabling managers to realise positive NPV projects in their firms' investment opportunity sets. Plantin (2006) also argues that because of reinsurance companies' close contractual relationships with direct insurers and their regular monitoring of insurers' underwriting and claims settlement systems, reinsurance can serve as an important signalling device to investors as to insurers' future financial condition. Shimpi (2002) further contends that the contingent capital properties of (re)insurance can help lower annual combined loss ratios (i.e., claims plus expenses including commissions as a proportion of net premiums written) as well as reduce the required level of retained equity capital. This attribute can help signal surety to investors thus reducing the cost of capital and increasing returns for shareholders. The implied market signalling benefits of reinsurance can help direct insurance writers to reduce their equity cost of capital. Froot (2008) points out that holding too much equity in insurance firms is not only expensive for investors but also increases the risk of resource misuse and excessive perquisite consumption by managers (see also Tufano, 1998). In other words, the frictional cost of capital in insurance firms can arise from agency incentive conflicts between management and owners (Laux and Muermann, 2010). Laux and Muermann (2010) further argue that as stock insurance firms invariably raise equity prior to selling policies, competition in insurance markets limits the amount of equity capital that can be raised at a cost that maximises their expected return on investment. However, as a contingent capital mechanism, reinsurance can relax equity limits and help optimise the allocation of capital in insurance firms in a way that financially benefits shareholders (Froot, 2007). Moreover, reinsurance can become economically advantageous to a direct insurance writer in the face of information asymmetries and agency problems such as the underinvestment and asset substitution

incentives (Doherty and Smetters, 2005; Jean-Baptiste and Santomero, 2000; Jensen and Meckling, 1976; Mayers and Smith, 1990). In other words, primary insurers are likely to reinsure when frictional costs exceed loadings for reinsurers' profits and expenses (Garven and MacMinn, 1993). On the other hand, reinsurance, if purchased in excess of the optimal level required by the insurer, can result in 'deadweight costs' because of the transaction costs and reinsurer's profit loadings (Froot, 2008). As long as the benefits of risk hedging via reinsurance outweigh the costs, then purchasing more reinsurance should lead to a reduction in the cost of equity, and vice versa. This analysis thus suggests that the relation between hedging and the cost of capital is likely to be non-linear. In a similar vein, Purnanandam (2008) argues that the propensity to use hedging increases with leverage, but this relationship reverses for extremely high levels of leverage. Indeed, Zou (2010) finds empirical evidence of a concave (inverted U-shape) relation between the purchase of property insurance and firm value (as measured by Tobin's q) in Chinese publicly listed companies (PLCs). Since firm value is inversely related to the equity cost of capital, one would expect the relationship between the cost of equity and extent of reinsurance to be convex (U shaped). Therefore the second test hypothesis is:

H2: Cost of equity of an insurer decreases with an increase in the level of reinsurance but reverses at high levels of reinsurance (ceteris paribus).

4.5 Conclusion

This chapter highlights that risk management (reinsurance) is an integral part of the capital structure of an insurer, and that reinsurance has a tangible effect on the equity cost of capital of a firm. Specifically, two hypotheses relating the cost of equity to reinsurance are put forward in this chapter. The first hypothesis investigates the effects of the decision to reinsure on the cost of equity, and predicts that reinsured insurers are expected to have a lower cost of equity. The second hypothesis relates the volume of reinsurance purchased to the cost of equity capital of an insurer, and postulates that the extent of reinsurance purchased and the cost of equity share a non-monotonous relationship. More specifically, it is predicted that the cost of capital traces a U-shaped curve as a

function of reinsurance. Models used to test both these hypotheses are presented in Chapter 6. This chapter also elaborates on other firm-specific factors that are likely to have an influence on the relationship between reinsurance and the cost of the equity of insurers. Proxies for such factors are used as control variables in testing the respective hypotheses. Before that, it is necessary to identify an appropriate method for estimating the cost of equity of an insurance firm and this will be examined in the next chapter of this thesis.

CHAPTER 5. COST OF EQUITY METRICS

5.1 Introduction

The cost of capital can be defined in different ways. From the managerial perspective, the cost of capital is the rate used to discount the future cash flows of a project under consideration; and from the investors' perspective, it is their expected rate of return commensurate to the risk undertaken. Therefore, estimating the cost of capital is important for making investment decisions, and corporate valuations. Since this study specifically examines the link between reinsurance and the equity cost of capital (given that conventional debt holdings in insurance firms is low), it is important that the metrics used to evaluate the relationship are reliable. The extant literature describes various methodologies that can be utilised to estimate the cost of capital. The techniques used for estimating the cost of capital can broadly be classified as valuation models and asset pricing models. Valuation models are generally used to make ex-ante forecasts of the equity cost of capital, whereas the asset pricing models lead to ex-post estimates of the equity cost of capital. To identify the most appropriate cost of capital estimation techniques a review of these methodologies is presented in section 5.2 below.

5.2 Valuation Models

The present value of any asset can be approximated by the discounted value of the future cash flows associated with it (Lintner, 1965). This approach is also known as the Discounted Cash Flow (DCF) technique. Moreover, the implied value of the discount rate (cost of capital) can also be calculated if other parameters used in the valuation are known. Put differently, under the valuation model approach, the cost of capital is defined as the discount rate that equates expected future cash flows with the present value of an asset. Based on the information used, the estimate may either

be the cost of equity or the firm-level cost of capital. To be precise, if dividends, the growth rate of dividends and the current share price are available inputs, the cost of equity can be estimated; whereas if firm-level data on free cash flows, their growth rate, and current value of the firm are used, then one obtains a measure of the firm-level cost of capital. DCF is essentially a financial market-based model that makes two key assumptions. First it is assumed that cash flows grow at a steady rate beyond a certain forecast (time) horizon; and second, that the firm/stock has an infinite life-time. Schmid & Wolf (2009, p. 342) suggest that these assumptions are more likely to hold in the case of mature industries like the property & liability insurance industry, which explains the widespread use of this model in that sector. According to Myers and Borucki (1994), DCF is the most widely used metric to estimate the cost of equity capital of regulated firms in the US and is also used extensively by insurance industry regulators. Not only this, DCF is a useful technique for insurance premium calculations (i.e., the ratemaking process) and has other desirable properties such as value additivity, and its ability to avoid accounting distortions and double counting (Cummins, 1990, p. 83)²². Assuming a steady-state growth rate of ' g_n ' for free cash-flow ' FCF ' is achieved after n years and the weighted average cost of capital is ' $WACC$ ', the current value of firm ' V ' can be defined as:

$$V = \sum_{t=1}^n \frac{FCF_t}{(1+WACC)^t} + \frac{FCF_n / (WACC - g_n)}{(1+WACC)^n} \quad (5.1)$$

A simpler version of the same model can be obtained by assuming a perpetually constant growth rate for associated cash flows. For this assumption to hold, two key conditions must be satisfied. First, the growth rate used in the model must be less than or equal to the growth rate in the economy, as no company/industry can perennially outperform the market because competition wipes out any abnormal return in the long run. Second, the reinvestment rate used to arrive at free cash flow estimates must be consistent with, or must have been derived from, the long-term growth rate. This is so because if the reinvestment rate is not a function of expected

²² Value additivity refers to the notion that value of a firm can be obtained by adding the net present value of future cash flows on all the individual projects that the firm undertakes.

growth, the free cash flow to the firm needs to be estimated using accounting statements, which are sensitive to the ratio of capital expenditure and non-cash adjustments such as depreciation. This arises as using net capital expenditures and changes in net working capital as an alternative to estimate reinvestment rates requires one to set the ratio of capital expenditure to depreciation equal to the industry average for a given year²³. Such an approach also requires that the change in net working capital generally be positive, as negative change in net working capital creates a cash inflow which might be feasible in the short term or in a particular industrial sector (e.g. retailing) but may be inaccurate if perpetuity assumption is invoked. On the other hand, where the reinvestment rate is estimated from the growth rate, which in turn is a function of the return on capital, firm value can be highly sensitive to changes in the estimated return on capital. Despite these limitations, DCF is nevertheless an important technique to estimate the cost of capital, and it is used widely both in the academic literature as well as in business practice (Brealey, Myers and Allen, 2011). Similar assumptions made in the context of cash flows to the shareholders can also be used to estimate the cost of equity. The dividend discount model is one such example and this is outlined in sub-section 5.2.1 below.

5.2.1 Dividend Discount Model (DDM)

Assuming a perpetually constant growth rate of g for dividend per share ' D ' and the current value of stock price per share as ' P ', the cost of equity capital (k_e) can be defined as:

$$k_e = \frac{D}{P} + g \quad (5.2)$$

Equation 5.2 above is also referred to as the 'dividend growth model'. A widely used variant of the DDM is the 'Gordon dividend growth model', attributed to Gordon (1959). The Gordon model assumes that: (1) the industry in question returns cash to shareholders; (2) dividends paid are a fixed proportion of annual earnings; and (3)

²³ According to Brealey, Myers and Allen (2011, p. 785) short term or current assets and liabilities are collectively known as working capital. Net working capital is defined as the difference between current assets and current liabilities.

dividend payments grow at a steady rate perpetually. The first assumption also encompasses share repurchases in case the shares being bought-back are retired (i.e., not being redistributed among employees and staff). As noted above, these assumptions are more likely to hold in the case of mature industries like the UK's non-life insurance industry. Owing to its simplicity, this model is quite popular in practice, but has few notable limitations (Brealey et al., 2011). First, this model cannot be used for firms that do not pay dividends, or are not publicly listed. Also, a constant growth rate of dividends implicitly assumes that distributable earnings grow perpetually at a steady rate, which is unlikely to hold in reality. Moreover, this model requires a long time series of dividend forecasts as the effect of future dividends on valuation diminishes at a slow rate. However, a model that overcomes these limitations of DDM is the abnormal earnings growth (AEG) model. This model is described next in sub-section 5.2.2.

5.2.2 AEG Model

Ohlson and Juettner-Nauroth (2005) relax the second and third assumptions relating to the Gordon growth model (noted in sub-section 5.2.1 above) to establish expected earnings per share and its growth as determinants of firm value. In particular, they assume that dividends paid per share ' D ' need not be a fixed proportion of earnings per share ' EPS ', and that there exists a distinct short term growth rate ' g_s ', apart from a long-term perpetual growth rate ' g_p ', which asymptotically decays to a perpetual growth rate with rate of decay ' δ '. Their study goes on to derive the AEG model to estimate cost of equity capital ' k_e ' from the valuation relation so obtained. Gode and Mohanram (2003, p. 403) mathematically represent the AEG metric as:

$$k_e = A + \sqrt{A^2 + \frac{EPS_1}{P}(g_s - (\delta - 1))}$$

$$\text{where, } A = \frac{1}{2}((\delta - 1) + \frac{D}{P}); g_s = \frac{EPS_2 - EPS_1}{EPS_1}; g_p = \delta - 1; 1 \leq \delta \leq (1 + k_e) \quad (5.3)$$

They further elaborate that the abnormal change in earnings within the framework of AEG is defined as the change in earnings in excess of the return on net reinvestment during the period, i.e. $k_e (EPS_1 - D)$. Penman (2005) lists two main advantages

provided by the AEG. First is that AEG valuation does not require 'clean surplus' accounting and so it can be applied on a per share basis²⁴. Second the AEG model allows for more general growth rates, especially in the case of finite horizon valuation with truncation. He further adds that AEG assumes a growth rate for residual earnings that declines geometrically to a lower rate in the future (e.g., towards the annual growth rate of GDP), which is more likely to hold in reality. Even with these advantages, the AEG model is still a valuation model and hence subject to the inherent limitations of all valuation models (e.g., requirement of mark-to-market accounting data). Besides, as AEG avoids the need for 'clean surplus' accounting, it remains unclear which definition of earnings is appropriate to use so that all the available information is incorporated in the valuation. For example, the use of earnings before interest, tax, depreciation and amortisation (EBITDA) is incorrect as EBITDA does not incorporate the effect of depreciation and creditors' claims on earnings, which if considered, results in a reduction in a firm's free cash flows as well as dividends to the shareholders. Another model that makes similar assumptions as AEG, and provides some cursory guidance on the definition of earnings to be used is called the residual income valuation (RIV) model. The RIV model is described next in sub-section 5.2.3.

5.2.3 RIV Model

The RIV model relies on 'clean surplus' accounting to value the equity of a firm. However, in reality such a condition is difficult to observe owing to the provisions of GAAP that form the basis of financial reporting by firms (including insurers) operating in the UK, and indeed elsewhere. In essence, the concept of 'clean surplus' is embodied by comprehensive income (C), and Sutton (2004, p. 131) defines it as the overall change in net assets (NA) in the year, excluding the effects of dividends (D) and changes in share capital (ΔSC). Thus for year t :

²⁴ Penman (2007, p. 269) explains that the notion of clean surplus refers to the condition that all the items of income appear on the income statement, and the net income so obtained is the only item transferred to the equity statement.

$$CI_t = (NA_t - NA_{t-1}) - \Delta SC_t + D_t \quad (5.4)$$

In the equation (5.4) above, the change in share capital is defined as the difference between the capital increase and capital decrease in year t. Such an approach is aimed at eliminating the non-comprehensive, hence 'un-clean', nature of the net income reported in the income statement produced under GAAP²⁵. Apart from the accounting identity shown in the equation (5.4), the RIV framework assumes that the current value of the firm is the discounted value of the future residual income generated by its productive assets. Moreover, the specification of the valuation model following the RIV framework is dependent on the assumptions made about the terminal value of a firm. For example, Claus and Thomas (2001) assume that the residual earnings grow at a constant rate beyond the forecast horizon, whereas Gebhardt, Lee and Swaminathan (2001) assume that return on equity (ROE) will linearly decay to an industry-based ROE in 12 years. Subject to the maintained assumptions listed above, the current share price ' P_0 ' can be expressed as a function of book value ' B ' per share, steady state growth in clean surplus ' g ', realised return on equity ' ROE ' and cost of equity capital ' k_e '. That is:

$$P_0 = B_0 + \sum_{t=1}^n \frac{(ROE_t - k_e)B_{t-1}}{(1+k_e)^t} + \frac{[(ROE_n - k_e)(1+g)B_{n-1}]}{(k_e - g)(1+k_e)^n} \quad (5.5)$$

A major contribution of the RIV model is that it incorporates widely available accounting information into the estimation equation, which at the same time is the source of its major criticism. This is due to the fact that residual surplus accounting cannot be applied on per share basis in case there are anticipated share transactions such as exercise of employee stock options. As Penman (2005, p. 370) states "...value from anticipated share transactions executed at more or less than fair value are not captured in a RIV valuation". Therefore, per share values used in valuations may result in erroneous valuations and non-optimal estimations of the implied cost of equity. Another criticism of models using analysts' forecasts of earnings for valuation,

²⁵ Frequently, unrealised gains or losses on securities available for sale; unrealised gains or losses on revaluation of fixed assets; foreign currency translation gains and losses; and gains and losses on derivative instruments are amongst the main items that go unreported in the income statement, thus making it non-comprehensive.

such as AEG and RIV, is that the forecasts used may be biased in the first place. For example, Easton (2006) points out that the estimates obtained may themselves lead to biases in estimating the cost of capital as analysts making sell (or buy) recommendation implicitly forecast negative (positive) abnormal returns, which results in a lower (higher) cost of capital than its true value. Easton (2004) however, derives a valuation model based on the ratio of price to earnings (PE) ratio and the short-run earnings growth rate, called price-earnings growth (PEG) ratio that reduces the bias induced by biased growth forecasts.

5.2.4 Price Earnings Growth (PEG) Model

The PEG model is derived from the AEG model; indeed, Easton (2004) presents it as a special case of AEG model described in Ohlson and Juettner-Nauroth (2005). The key insight from Easton (2004) is that the difference between accounting earnings and economic earnings characterises the role of accounting earnings in corporate valuation. Using current prices, and three elements of earnings forecasts, namely forecasts for the next period earnings, short-run earnings growth and the change in earnings growth rate beyond the forecast horizon; Easton (2004) derives a method for estimating the implied rate of return. There are three different sets of assumptions that are employed to arrive at three different formulations, least restrictive of which is being reproduced here. Assuming unequal forecasts for accounting and economic earnings, and that abnormal growth in accounting earnings do not remain constant in perpetuity, Easton's (2004) PEG model uses a third growth variable that captures changes in forecasts of abnormal growth in accounting earnings beyond the forecast horizon. This can then be used to adjust the difference between forecasts of accounting and economic earnings so that an estimate of expected rate of return (or valuation) can be obtained. Assuming no temporal arbitrage condition, and denoting current price, forecasted earnings, expected abnormal growth in accounting earnings, dividend and required rate of return by P , EPS , AGR , D and k_e respectively, the PEG model specifies that:

$$P_0 = \frac{EPS_1}{k_e} + \frac{1}{k_e} \sum_{t=1}^{\infty} \frac{AGR_t}{1+k_e} \quad (5.6)$$

where, $AGR_t = EPS_{t+1} + k_e * D_t + (1+k_e)EPS_t$

Moreover, by defining a perpetual rate of change in abnormal growth in earnings ΔAGR beyond the forecast horizon, the equation (5.6) above can accommodate a finite forecast horizon. For example, if one assumes that earnings forecasts are available only for the next two periods, equation (5.6) can then be written as:

$$P_0 = \frac{EPS_1}{k_e} + \frac{AGR_1}{k_e(k_e - \Delta AGR)} \quad (5.7)$$

where, $\Delta AGR = (AGR_{t+1} / AGR_t) - 1$

If one further assumes that the next period's forecast for abnormal growth in earnings is an unbiased estimator of abnormal growth in earnings in all subsequent periods, then the rate of change in AGR, denoted by ΔAGR , equals 0. The cost of equity, k_e can then be estimated as the positive root (negative cost of capital is meaningless) of the following quadratic equation, where all the variables are as defined for equation (5.6) above:

$$k_e^2 - k_e \frac{D_1}{P_0} - \frac{(EPS_2 - EPS_1)}{P_0} = 0 \quad (5.8)$$

However, a special case arises if along with ΔAGR , the dividend forecast for the next period is also assumed to be nil ($D_1=0$). Under this condition, the cost of equity is equal to the square root of the inverse of the product of PEG ratio and 100. Mathematically, the cost of equity can be calculated by using the relation:

$$k_e = \sqrt{\frac{EPS_2 - EPS_1}{P_0}} \quad (5.9)$$

Due to its close association with the PEG ratio, the equation (5.9) is sometimes referred to as the PEG model for estimating the cost of equity and the equation (5.8) is referred to as the modified PEG model (MPEG) as it incorporates the dividend forecast along with earnings growth in estimation. Botosan and Plumlee (2005) find

that the cost of equity estimated using the PEG model is consistently associated with five commonly accepted firm-level risk proxies – namely, market risk, leverage, information risk, firm size and growth. Lee, Walker and Christensen (2006) also find that the PEG model tends to be more suited in the European corporate context as it does not depend on the ‘clean surplus’ assumption. Despite these advantages, the PEG model has certain limitations, such as the requirement that earnings forecasts and growth must be positive and that this limitation could bias samples towards less risky firms thus producing unreliable estimates of the cost of equity (Lee et al., 2006). Penman (2007, p. 222) also cautions against the use of forecast growth rates in ex-dividend earnings instead of cum-dividend earnings, and single year estimates of anticipated growth as it ignores information about subsequent growth. Apart from these restrictions, there are other considerations that determine the utility of the PEG model and other valuation models in estimating the cost of equity capital of a non-life insurance company which will be explained in greater detail in section 6.4 of Chapter 6. Another class of models that is used extensively in the insurance industry are asset pricing models (Cummins and Harrington, 1988). These models are considered in section 5.3 below.

5.3 Asset Pricing Models

Like valuation models, asset pricing models also stem from the basic premise that the price of an asset is the discounted value of its expected payoff. Cochrane (2005) defines two fundamental costs of capital estimation approaches that derive from asset pricing theory – namely, absolute pricing and relative pricing. Under the absolute pricing approach, an asset is priced by reference to its exposure to fundamental sources of macroeconomic risk, such as market risk. Good examples of this approach are the arbitrage pricing theory (APT) approach, the capital asset pricing model (CAPM) and related factor models. However, in practical applications, the absolute approach does not work and as a result, relative pricing is required. For example, the CAPM prices assets relative to the market, without explaining what determines the market value and accompanying risk premium or beta (Roll, 1977). On the other

hand, the relative pricing attempts to value an asset, given the prices of some other assets, which is elegantly reflected in the option pricing technique of Black and Scholes (1973). A more detailed discussion of these models is presented in sub-sections 5.3.1 to 5.3.3 below.

5.3.1 The CAPM

The development of the CAPM is attributed to Sharpe (1964) and Lintner (1965). In these studies, the CAPM arises as a consequence of an analysis of the process by which investors construct efficient portfolios²⁶. By assuming that investors can lend and borrow at the risk free rate, it is possible to identify an efficient portfolio having the highest ratio of risk premium to standard deviation which dominates all the other portfolios. Implicit in such an analysis is the key assumption that expected return on a security depends on the risk stemming from economy-wide influences and is not affected by specific (idiosyncratic) risk (Brealey et al., 2011). Under the CAPM framework, the rate used to discount the future cash flows of an asset must incorporate the time value of money and the risk inherent due to uncertain future payoffs. The CAPM incorporates the concept of the time value of money by using the risk-free rate of return, usually defined as the yield on government securities. On the other hand, the risk inherent in an investment is characterised by the covariance of its return with the market risk premium. The market risk premium is the excess return gained by investing in the market instead of a risk-free asset. Assuming the risk aversion of investors remains unchanged over time, historical excess returns can provide a reasonable estimate of market risk premium. For estimating the market rate of return, generally, return implied by broad based share price index is used. If R_i , R_f and R_m represent the expected return on an asset, risk-free rate and market rate of return respectively, then according to CAPM:

²⁶ Portfolios that offer the highest expected returns for a given standard deviation are known in the finance literature as efficient portfolios (e.g., see Brealey et al., 2011).

$$R_i = R_f + \beta_i (R_m - R_f)$$

$$\text{where, } \beta_i = \frac{\sigma_{im}}{\sigma_m^2} = \frac{\rho_{im}\sigma_i}{\sigma_m} \quad (5.10)$$

The parameter β_i in equation (5.10) is a measure of systematic risk reflecting the variability of returns of a firm's shares in relation to the market as a whole. Mathematically, it is equivalent to the ratio of covariance, σ_{im} , between the returns of an individual stock and the market portfolio, and the variance in the returns on the market portfolio σ_m^2 . Aside from its simplicity and widespread use, the CAPM has some notable limitations. First, being a single factor model, it overlooks other factors that might affect the returns. In fact, Fama and French (1995) find that firm size and book-to-market ratio are important factors in determining expected returns. In a subsequent study, Fama and French (1997) propose a new model for the cost of equity estimation, known as the Fama-French Three Factor (FF3F) Model, by incorporating risk factors that help to control for the effects of firm size (market capitalisation) and growth prospects (the book-to-market equity ratio) factors into the CAPM. Representing risk premia for market factor, size factor and growth factor by RP_m , RP_s and RP_b respectively; and sensitivity of stock returns to these factors by β_m , β_s and β_b respectively, the FF3F model is expressed as:

$$R_i = R_f + \beta_{mi} * RP_m + \beta_{si} * RP_s + \beta_{bi} * RP_b \quad (5.11)$$

The FF3F model in the equation (5.11) predicts that large firms will tend to have relatively lower costs of equity than small firms because of their generally lower risk profile. The book-to-market ratio is often interpreted as providing a market risk premium to account for possible financial distress (Fama and French, 1995). Therefore, other things being equal, firms whose investment opportunity set comprises more growth options than assets-in-place are expected to have higher costs of equity than other firms. However, Brealey et al. (2011) report that sensitivity to these risk factors varies by industry. Not only this, factor betas might change over time, which limits the FF3F model's applicability in case of companies with shorter return series. For example, Cummins and Phillips (2005, p. 449) assert that the FF3F

model requires lengthy estimation periods of 30 years or more to derive robust results.

Some other major limitations with the CAPM and its multifactor variant, the FF3F model have also been highlighted in academic finance. For example, Lee and Cummins (1998) argue that the CAPM is not only a single-period model and so cannot deal with cross-temporal variations in firms' risk profiles (e.g., betas), but that it is also founded on assumptions of perfect information in markets and multivariate normal securities' returns, which are unlikely to hold in reality. Therefore, alternative metrics have been developed in an attempt to overcome the acknowledged deficiencies of the CAPM. For instance, Lambert, Leuz and Verrecchia (2007) recast the CAPM into a form that explicitly allows for multiple firms whose cash flows are correlated. They show that the ratio of expected future cash flows to the covariance of the firm's cash flows with market cash flows is a key determinant of the cost of equity capital and that public information in the market reduces the risk premium and hence the cost of equity. Another model that overcomes the single factor limitation of CAPM is the APT model. The key features of the APT model are presented in next subsection 5.3.2.

5.3.2 APT Model

Unlike the CAPM, Ross's (1976) APT model does not raise the question about portfolio efficiency, but rather assumes that returns on a firm's stock depend collectively on macroeconomic risk factors along with idiosyncratic events unique to the firm. Ryan (2007) explains that the main idea behind APT is that for any given security or portfolio, it is possible to create another synthetic portfolio of identical risks, and in competitive markets, under the law of one price, the return offered on these portfolios should be identical too. Based on this 'no arbitrage' argument, two key conclusions can be drawn. First, that all security returns should be linear with respect to the factors which capture the various risks of those securities. Second, that it is possible to create a risk-free portfolio by combining securities which taken together have zero risk relative to macroeconomic factors driving risk in the market,

once firm-specific risk has been diversified away. This feature is similar to that of the CAPM, which postulates that risk arising from pervasive macroeconomic factors cannot be eliminated, whereas diversification eliminates specific risk related to a firm's portfolio. Accordingly, APT holds that the expected risk premium on a stock should depend on the expected risk premium associated with each of the macroeconomic risk factors (RP_j) and the share's sensitivity (β_{ji}) to each of these factors (Brealey et al., 2011). Mathematically this relation can be expressed as:

$$R_i = R_f + \beta_{1i} * RP_1 + \beta_{2i} * RP_2 + \dots + \beta_{ni} * RP_n \quad (5.12)$$

Lee and Cummins (1998) show that the APT model represented in the equation (5.12) above produces more reliable cost of equity estimates than the CAPM; but they report that it is rarely used in practice for various reasons. These reasons include the heavy constraints that the APT model places on data (e.g., the requirement for synchronous and frequently traded share price data) and the difficulty of determining macroeconomic factors' effects on securities' returns within and between industries and countries, and also over time. Various developments on the CAPM and APT models have been reported in the literature. For example, Wei (1988) develops a hybrid of the CAPM and APT metrics and demonstrates that this hybrid model is an important advancement on the simplified CAPM. However, the hybrid model still retains many of the shortcomings of the CAPM and APT concepts such as the single period context and potentially confounding institutional and economic sector effects arising due to the assumption of the normality of returns required for deriving this model. Wen et al. (2008) suggest that the CAPM should not be used when companies' equity returns are not normally distributed. Consequently, they use the non-parametric Rubinstein-Leland (R-L) model (Rubinstein, 1976; Leland, 1999) to calculate the cost of equity for US property-liability insurance companies.

5.3.3 Rubinstein-Leland (R-L) Model

He and Leland (1993) show that the CAPM-based beta does not capture skewness and other higher order moments of the return distribution that may be valuable to the investors. Leland (1999) adds that a risk measure must capture an infinite number of

moments of the return distribution. Rubinstein's (1976) study presents a pricing formula for the valuation of uncertain income streams assuming a power utility function for the investor and lognormal return for the market portfolio. It must be noted here that the assumption of lognormality does not apply to the returns on individual assets constituting the market portfolio, as a portfolio of assets with lognormal returns will not itself have lognormal return. However, the R-L model being non-parametric, provides robust estimates for the price of any asset with any arbitrary distribution, and is thus able to capture an infinite number of moments (Wen et al., 2008). Accordingly, if X_1 is the terminal payoff, R_m the return on market portfolio; R_f the return on risk-free asset; b the degree of risk aversion of the assumed power utility; $Cov(u,v)$ covariance of any two variables u and v ; and $E(.)$ the expected value operator, then the current price P_0 of an asset can be represented as:

$$P_0 = \frac{E(X_i) - \frac{Cov(X_i, -(1+R_m)^{-b})}{E(1+R_m)^{-b}}}{1+R_f}$$

$$where, b = \frac{1}{2} + \frac{E[\ln(1+R_m)] - \ln(1+R_f)}{Var[\ln(1+R_m)]} \quad (5.13)$$

Based on equation 5.13 above, Leland (1999) derives a linear risk-return relationship that is very similar to CAPM:

$$R_i = R_f + B_i(R_m - R_f)$$

$$where, B_i = \frac{Cov[R_i, -(1+R_m)^{-b}]}{Cov[R_m, -(1+R_m)^{-b}]} \quad (5.14)$$

By setting the degree of risk aversion 'b' equal to 4, Wen et al. (2008) calculate the cost of capital of US-based property-liability insurers using R-L model and the CAPM²⁷. Their study finds systematic differences in the estimated cost of equity using

²⁷ Leland (1999) suggests that the degree of risk aversion of a representative investor can be viewed as the "market price of risk", and can be estimated by dividing the market's instantaneous excess rate of return by the variance of the market's instantaneous rate of return. Accounting for the effects of human capital and the mean reversion character of stock

the two methods for non-life insurers having returns with severe departures from normality and/or insurers that are relatively small in size.

5.4 Conclusion

This chapter reviewed various methods that may be utilised to estimate the cost of equity capital. These models are classified as valuation based models or asset pricing models. Valuation models generate the ex-ante cost of equity estimates using forecast data, whereas asset pricing models generate ex-post estimates using historical returns. Although valuation models in general correlate better with the common risk proxies, they are data intensive and their applicability is subject to the availability of relevant data which might not be available for relatively smaller companies and privately held corporations. On the other hand, asset pricing models require less input, but correspond less to common risk proxies. Therefore, none of the models emerges as the unequivocal frontrunner to be adopted as the best available technique, as all of them have certain appealing features and a few limitations. The applicability of each model in the context of the present study will be determined by the availability of input data, and the relevance of assumptions made by the model in the case of the insurance industry. The determination of the best cost of equity metric for the present study will be considered in the Research Design section (Chapter 6) of this thesis.

index, Campbell (1996) estimates the value of risk aversion parameter 'b' to be 3.63. For simplicity, Wen et al. (2008) use nearest integer value of this estimate of 'b' in their calculations.

CHAPTER 6. RESEARCH DESIGN

6.1 Introduction

This chapter provides a rationale for the selection and application of an appropriate method for the empirical research undertaken in this study. In section 6.2 an overview of the appropriate research methods is presented along with the justification for the research methods used. A description of the data sources, and the sample selection method employed are provided in section 6.3. Section 6.4 then outlines the procedure adopted for estimating the cost of equity, while section 6.5 defines and elaborates on the motivation for including the relevant variables used in this study. The respective models used to test the two hypotheses presented in Chapter 4, along with appropriate econometric procedures employed to implement these models, are detailed in sections 6.6 and 6.7. Finally, section 6.8 concludes the chapter.

6.2 Research Methods

Statistical analysis, questionnaires, and face-to-face interviews are the prime candidates for collecting and analysing the data required in the context of empirical research. The latter two methods are versatile as they are suitable for both quantitative as well as qualitative research, while statistical analysis is appropriate only for quantitative research (Sarantakos, 2005). According to Hoyle, Harris and Judd's (2002), data collected through questionnaires suffer from poor data quality (accuracy and completeness) and often low response rates. Interviews too have limitations as they are prone to biased answers from respondents and measurement errors arising due to the misinterpretation and/or incorrect framing of questions (Snow and Thomas, 1994). Statistical analysis, on the other hand, is considered to be the most robust and appropriate technique to test hypotheses derived from theory. This is because statistical results can be

generalised and reproduced rendering them more robust and defensible under scrutiny (Watts and Zimmerman, 1990; Sarantakos, 2005). Although it would be ideal to use field-based methods in conjunction with statistical analysis, time and cost constraints rule out the use of these methods in the current study. Not only this, a low response rate using field-based methods can curtail the size of the sample drawn from non-life insurance companies operating in the UK. A small estimation sample can make inferences drawn from this study to be deemed unreliable. Accordingly, statistical analysis emerges as the most appropriate research method to be employed in this study.

Statistical analysis is the best approach for this study for at least two other reasons. First, since the study (like most studies published in academic finance literature) is empirical in nature, it is essentially quantitative, and therefore more amenable to the tools of statistical analysis. Second, as stated above, the results obtained by using statistical analysis being generalisable, fit well with the stated hypotheses of this study. This is because the hypotheses presented in this study generalize the observed behaviour of the individual firms to that of the average firm operating in the industry. Moreover, given the use of independently audited secondary data, statistical analysis is likely to produce more reliable and unbiased results, which may not be the case with data collected using field-based methods.

6.3 Data Sources

Data used in this study are derived from two sources. The first data sources are the regulatory returns filed by the licensed general insurance companies operating in the UK to the insurance industry regulator – the FSA. SynThesys Non-Life Insurance Database provided by Standard & Poor's (2011) compiled the regulatory returns filed by 469 insurance and reinsurance companies operating in the UK non-life insurance market between 1985 and 2010. This database was carefully selected based on the aptness of the data provided and the cost of the database subscription in the context of this study. The time-window of this study mirrors the earliest and latest years for which the data were available when the empirical analysis was carried out. However, the SynThesys database does not provide consolidated returns of group companies as regulations require

independently operating and reporting insurers to file their returns individually, rather than on the basis of their group membership. Additionally, not all firm-year cases included in the database are usable (e.g., as a result of the negative values of accounting items (e.g., the negative values of gross annual premiums written) and missing observations). Therefore, as in Petroni (1992), and Gaver and Paterson (1999) amongst others, certain restrictions were imposed on the complete set of observations to derive a sample with plausible values of certain key parameters as described next. Only firm-year observations for which total assets, total gross premiums written, primary and direct gross premiums written, total capital resources, cash, capital reserve requirements, claims incurred, policyholders' surplus, paid-in capital and premiums ceded were reported to be positive, are included in the estimation sample. Further, this sample's 'filtering procedure' also required that the return on assets be greater than -1 for the firm-year to be included in the sample.

This 'filtering procedure' generated a sample of 380 firms (5075 firm-year observations) that were proactively writing primary insurance in at least one year over the study period. The resulting sample was further reduced, as only the firms having a premiums ceded to gross premiums written ratio of less than or equal to one were included in the sample. Again, this step was taken to eliminate implausible values, because a cession rate of higher than 100% is symptomatic of either a firm in 'run-off' or a case of misreporting. Adopting this procedure removes 128 firm-years, leaving 4,947 firm-years (379 firms) in the sample. To 'force' the data to be longitudinal (panel) in nature, the firms that do not have at least two consecutive years of observations are excluded from the estimation sample. This results in a sample of 363 firms with 4,773 observations. The second database used in this study is the Datastream (2012) database provided by Thomson Reuters, which was used to collect data required for calculating the cost of equity. Specifically, data on the Financial Times Stock Exchange (FTSE) Non-Life Insurance Index were used to calculate returns for the UK non-life insurance sector²⁸, whereas the FTSE All Share Index was used for calculating the market

²⁸ As the name suggests, the FTSE 350 Nonlife Insurance Index is a market-capitalisation weighted index of all the companies in the non-life insurance sector of the FTSE 350

return²⁹. Details of the procedure employed to calculate cost of equity capital are provided in the following section (6.4).

6.4 Cost of Equity Estimation

As mentioned in Chapter 5, there are various techniques for calculating the cost of the equity of a firm, but their application is often constrained by the availability of the requisite data. It has been reported in the academic literature that market-based accounting methods provide the most accurate estimates of the cost of equity as these estimates tend to correspond well with the usual risk proxies (e.g., see Botosan and Plumlee, 2005). Since these techniques are by definition market based, these techniques are useful only for publicly quoted firms. This is so because the long time series of earnings and/or dividend forecast data required for estimating the equity cost of capital using these techniques are available only for widely held listed firms. Insurance (composite and pure non-life insurers) firms listed on the London Stock Exchange (LSE) however, represent only a small proportion (27 out of 701 licensed firms in 2010) of the total population of UK-licensed general insurers³⁰. Results obtained using a sample of only 27 firms would not be generalisable; hence in the interest of maintaining a representative sample of a decent size, the idea of applying estimation techniques using market-based accounting was discarded. Following this, a technique had to be chosen from different estimation models based on asset pricing theory. The selection procedure is described as follows.

The first cost of equity model considered was the APT model of Ross (1976), which, according to Lee and Cummins (1998), produces reliable estimates of the cost of equity, but is rarely used in practice. They further explain that the reason

Index. The index was developed with a base value of 1,000 as of December 31, 1985 (Datastream, 2012).

²⁹ The FTSE All-Share is a market-capitalisation weighted index representing the performance of all eligible companies listed on the London Stock Exchange's main market, that pass screening for size and liquidity. The FTSE All-Share Index covers approximately 98% of the UK's total market capitalisation (Datastream, 2012).

³⁰ However, other listed insurance firms (e.g. Allianz) in the sample are quoted in the stock exchanges based in the country of their respective parents.

for this is the severe restrictions placed on data by the APT model, such as the requirement of frequent trading. Moreover, the APT model does not identify the key macroeconomic risk factors that must be considered in estimation (e.g., the market risk, inflation risk, exchange rate risk etc.). In view of these restrictions, the APT model was not selected for estimating the cost of equity. The next cost of equity model to be considered was the widely used CAPM of Sharpe (1964) and Lintner (1965). The CAPM has certain desirable qualities in the context of this study. First, even though CAPM is fundamentally a market based technique, it can nevertheless be applied for non-listed firms if used in conjunction with the 'full information beta' (hereafter FIB) technology described in Kaplan and Peterson (1998). Indeed, Cummins and Phillips (2005) successfully apply the CAPM using FIB technique in the case of US-based non-listed property-liability insurers. They further assert that such methodology can be used for calculating the cost of capital of mutual companies as well. Consequently, the CAPM does not impose severe limitations on the data in terms of organisational form or the listing status of the insurance firm. As discussed in section 5.3.1 of Chapter 5, there are, however, certain limitations of CAPM as well. For example, it is a single period model so cannot take into account changes in risk profile of the firms over time; the CAPM also makes unrealistic assumptions of the normality of security returns.

One of the limitations of CAPM, i.e. the assumption of return normality, can be overcome by using the R-L model attributed to Rubinstein (1976) and Leland (1999). The R-L model was therefore considered next. The R-L model assumes the log-normality of market returns, but does not make any distributional assumptions regarding the returns of a particular stock. Wen et al. (2008) operationalise the R-L model for US property-liability insurance companies, and report that the R-L model, being distribution-free, provides better estimates (in terms of proximity to realised returns) of portfolio return for insurers with highly skewed returns, and/or a relatively small size. Moreover, like the CAPM, FIB methodology can be used with the R-L model thus preserving the sample size. Given these attributes, the R-L model was used as the primary method for estimating the cost of the equity of firms in the aforementioned sample. The CAPM however was also used to provide a secondary benchmark estimate in order to

facilitate comparative analysis and checks for the robustness of the hypotheses. The nature of the FIB procedure is considered next.

The FIB procedure to compute industry-level betas outlined in Kaplan and Peterson (1998) was used in this study to estimate the industry level betas for each line of business. In turn, these values were used to calculate the firm level betas. Cummins and Phillips (2005, p. 447) state that the “...FIB methodology produces cost of capital estimates that reflect the line of business composition of the firm”. They further explain that in arbitrage free markets the value of a firm can be considered as the sum of the values of individual assets (lines of business) owned by the firm. Therefore, it follows that a firm’s beta can also be represented as the sum of beta coefficients of individual lines weighted by their corresponding weights representing their proportional contribution to the firm’s market value. Due to individual lines not being traded in the market, the market value of individual business lines is not known. Therefore, following Kaplan and Peterson (1998), revenues for six lines of business at the industry and firm level are used in this study to proxy for the relative weight of each line at the industry-level and firm-level respectively³¹. Within the framework of the FIB, the initial step using the R-L metric is to calculate industry level beta corresponding to each of the available monthly observations using the following equation:

$$\beta = \frac{Cov[R_i, -(1 + R_m)^{-b}]}{Cov[R_m, -(1 + R_m)^{-b}]}$$

$$\text{where, } b = \frac{1}{2} + \frac{E[\ln(1 + R_m)] - \ln(1 + R_f)}{Var[\ln(1 + R_m)]} \quad (6.1)$$

As is evident from the equation (6.1) above, the three key inputs required for estimation are R_i - the return on a portfolio of non-life insurance companies; R_f – the return on the risk-free asset and R_m – the return on the market portfolio. The proxies used for all these variables were obtained using data from Datastream (2012). As mentioned in section 6.3, the FTSE 350 Non-life Insurance Index was used to proxy R_i , the monthly return on the industrial sector. Data on this index are

³¹ Owing to the availability of coherent data six major groups of insurance business are classified as different lines in this study. These are: personal accident; motor insurance; property insurance; liability insurance; marine, aviation & transport insurance; and miscellaneous and financial loss.

available from December 1985 onwards. The risk-free rate, R_f was estimated using the monthly return on the UK government Treasury Bill of one month maturity as it precisely matches the duration of returns on the insurance industry index and the market index. Similarly, the return on the FTSE All-Share Price Index was used to approximate the monthly market return. It is important to note here that there is a mismatch of the duration of data available on the FTSE 350 Non-Life Insurance Index, which is based on data from December 1985 and the data available from SynThesys Non-Life, which provides data from 1985 onwards. Therefore to avoid losing one year's data in the estimation, the bootstrap method utilising the full sample of available returns was employed to estimate the yearly industry beta for each year from 1985 to 2010 (see Appendix A). However, industry beta can also be calculated using the CAPM with the same set of variables used for estimating betas using the R-L model and employing the following equation:

$$R_i = R_f + \beta(R_m - R_f) \quad (6.2)$$

Yearly industry betas so obtained from the equations (6.1) and (6.2) were then regressed on the annual weights of each of the individual lines over the estimation period with the constant term suppressed. If β_t represents annual industry beta for year 't'; β_j represents beta of an individual line 'j'; and ω_{jt} represents weight of line j in year 't', then mathematically:

$$\beta_t = \sum_{j=1}^6 \beta_j \omega_{jt} + v_t \quad (6.3)$$

Suppression of the constant term ensures that the estimation procedure conforms to value-additivity property assumed in the FIB framework, as the industry beta must be equal to the weighted sum of the individual line betas (e.g., see Cummins and Phillips, 2005). Line betas, represented by β_j , so obtained are then used to calculate the firm level yearly beta β_{it} using the following equation:

$$\beta_{it} = \sum_{j=1}^6 \beta_j \omega_{ijt} \quad (6.4)$$

In equation (6.4) above, ω_{ijt} represents the weight of by-line business premiums written by a firm 'i' in year 't' as a proportion of the annual gross premiums written by the firm in that year. In the next step in this procedure, using the yearly betas

for individual firms, the risk premia for individual firms for each year in the study period were calculated using the following mathematical relationship:

$$RP_{it} = \beta_{it}(R_m - R_f) \quad (6.5)$$

In the equation (6.5) above, the market risk premium is represented by the difference between the return on the market portfolio and the risk free asset, denoted by R_m and R_f respectively. Using the long-run average of risk premium is used as short term estimates of risk premium could be confounded by period specific environmental (e.g., macroeconomic) events (Koller, Goedhart and Wessels, 2010). Therefore, to incorporate the long period estimates of risk premiums in this research project, the risk premium of 5.23% as reported in Table I of Kyriacou, Madsen and Mase (2006, p. 347) is used. Kyriacou et al. (2006) calculate the historical risk premium using UK-specific data from the year 1900 to 2002. As suggested in the academic literature, the arithmetic mean is employed in their study to arrive at this estimate (e.g. see Koller et al., 2010, p. 239). The yearly risk premia so calculated for each firm in the estimation sample serve as the dependent variable in testing each of the two hypotheses proposed. Other variables used in testing these hypotheses are described in section 6.5 below.

6.5 Explanatory Variables

All the variables described below are defined in the context of the sample (4,773 firm-years with 363 firms) that corresponds to the sampling procedure described in section 6.3. All the variables used in this study are summarised in Table 6.1.

6.5.1 Reinsurance

Since this research study primarily aims to explain the effect of reinsurance on the cost of the equity of the insurers, the principal explanatory variables (decision to reinsure and the extent of reinsurance) used in this research are derived from the premiums ceded to the reinsurers. To test the 'reinsurance decision' hypothesis (H1), an indicator variable, named REINID, which takes value 1 if a firm cedes any premiums to a reinsurer and 0 otherwise, is used. In the current study, 347 sample firms (nearly 96% of all the firms in the sample) use reinsurance with

approximately 95% of the firm-year observations (4,512 out of 4,773) indicating the use of reinsurance. To gauge the extent of reinsurance used by insurers relative to the gross premiums written at the total business level, the ratio of premiums ceded to gross premiums written (hereafter reinsurance ratio) is employed. The variable label *REINS* denotes the reinsurance ratio given in Table 6.1 below. The squared value of reinsurance ratio is incorporated along with the reinsurance ratio to test the non-linear dependence of the cost of equity on the reinsurance ratio.

Table 6.1: Definition of Variables

This table defines variables used in testing the hypotheses postulated in this study. All the variables pertain to the values for firm 'i' in year 't'.

Name	Denotes	Definition
RP_{it}	Risk Premium	Denotes estimated equity risk premium
$REINID_{it}$	Reinsurance Identifier	Indicator variable for use of reinsurance, takes value 1 if used, 0 otherwise
$REINS_{it}$	Reinsurance Ratio	Ratio of premiums ceded to gross premiums written at total business level
$REINS^2_{it}$	Square of Reinsurance Ratio	Square of the reinsurance ratio as defined above
LEV_{it}	Leverage	Difference between total assets and policyholders' surplus scaled by total assets
$SIZE_{it}$	Size	Natural logarithm of total assets
CAP_{it}	Growth	Ratio of difference of capital resources available and capital resource requirements to capital resources
LIQ_{it}	Liquidity	Cash scaled by total claims incurred
$HINDX_{it}$	Herfindahl Index	Sum of squares of the ratio of by-line premiums written to total premiums written at the firm level

6.5.2 Leverage

Prior research suggests that many factors can explain the observed risk premia. For example, in the seminal works of Modigliani and Miller (1958, 1963) leverage is considered to be an important factor in determining the cost of equity, and that the cost of equity increases with an increase in leverage. Jensen and Meckling (1976), and Jensen (1986) further contend that agency costs are also associated with debt, and as such, indirectly affect the cost of equity. Prior research studying the link between the cost of equity and firm risk characteristics (e.g. see Botosan and Plumlee, 2005) also uses leverage as one of the determinants of the cost of

equity. Following these studies, leverage is used here as one of the explanatory variables for observed risk premium. In the context of this study's leverage, LEV, is defined as the difference between total assets and policyholders' surplus scaled by total assets³².

6.5.3 Size

Fama and French (1995) demonstrate that size, and the book-to-market value ratio of a firm are significant factors in determining the risk premium demanded by investors. In Fama and French's (1997) FF3F model, firm size is inversely related to the cost of equity. Such a relationship between firm size and the cost of equity arises because larger firms have greater access to capital markets than smaller firms, plus, they are more diversified in terms of both geographical and product-markets. Berk (1995) also suggests that the market value and firm risk are inherently inversely related. In the same vein, Botosan, Plumlee and Wen (2011) define firm size as the natural logarithm of the market value of the firm. However, this measure is not possible in this study as most of the firms in the estimation sample are not publicly traded. Therefore, the natural logarithm of the total assets reported in the statutory annual returns filed by the insurers has been used to proxy for the size of the firm. It is considered that this is a reasonable proxy for two main reasons. Firstly, insurers are required by regulation to regularly (at least annually) mark their assets to market values for statutory solvency monitoring purposes, and second, a large proportion of insurers' assets are marketable securities which in any case are reported at, or close to their true market values.

6.5.4 Growth

Many studies report the book-value-to-market-value of equity ratio (BE/ME) to be positively related with the equity risk premium. Models explaining higher average returns on high BE/ME stocks, such as the APT model of Ross (1976), contend that the observed higher returns on high BE/ME stocks are compensation for an additional fundamental risk factor. Within the purview of this stream of research, BE/ME can thus be envisioned to represent the inherent growth opportunities of a

³² Policyholders' surplus is defined as the sum of paid-in capital, retained earnings and claims reserves.

firm. Davis, Fama and French (2000) also provide historical evidence in favour of this argument. However, due to the unavailability of BE/ME for most of the firms in the estimation sample a different proxy for growth capacity of the insurer is used in this study. UK based insurers are required to report their capital resources as well as their capital resource requirements to the insurance industry regulator in their annual statutory solvency returns. The regulations demand that the insurer must be able to meet its capital resource requirements using its own capital resources. Thus, an insurer with a higher difference between its capital resources and the stated capital resource requirements will have a lower risk profile and higher capacity to grow its gross premiums written and/or the underwriting profit. Therefore, to capture this growth component of risk, the difference between capital resources and capital resource requirements scaled by capital resources, denoted as CAP, is used in this study.

6.5.5 Liquidity

Insurers being financial intermediaries face significant liquidity risks on their balance sheets (Borde, Chambliss and Madura, 1994). BarNiv and Hershberger (1990) also suggest that liquidity risk is an important component of the potential financial distress costs of an insurer. The liquidity risks arise due to the possibility that insurers' investments (usually in marketable securities which are exposed to interest rate risk, market risk, and credit risk) will not be able to meet an increased demand for liquidity in the aftermath of a major catastrophe event. Borde et al. (1994) also report that liquidity has a positive and statistically significant relation with an insurer's risk. This view supports the argument that an insurer's liquidity level can lead to a more risky investment strategy. To account for this possibility, a variable representing the liquidity level of an insurer is also included in the estimation. The ratio of reported cash assets to claims incurred, denoted LIQ, is thus used to measure liquidity risk. As in Borde et al. (1994) the relation between liquidity risk and the cost of equity is predicted to be positive.

6.5.6 Product Diversification

One of the important considerations in determining firm-level risk is the level of product-market diversification of the firm. For example, Cole and McCullough

(2006, p. 176) assert that, "...differences in the lines of business sold affect a firm's investment opportunities, earnings volatility, and overall level of risk". Indeed, in their study Drew, Naughton and Veeraraghavan (2004) find that idiosyncratic volatility is priced in the stock market. Since a diversified insurance firm is likely to have lower volatility returns, a Herfindahl index (*HINDX*) is used in this study to measure product diversification in accordance with the prior research (e.g., see Mayers and Smith, 1990). This variable (*HINDX*) is defined as the sum of squares of the premiums generated by individual lines of business as a proportion of the total premiums written at the total business level. In other words, for a firm 'i' operating in 'N' different lines of insurance in a given year 't', the Herfindahl index can be calculated as:

$$HINDX_{it} = \sum_{j=1}^N \left(\frac{GPW_{ijt}}{GPW_{it}} \right)^2 \quad (6.6)$$

where j represents the number of lines

A small *HINDX* (significantly less than 1) represents a highly diversified company, whereas for a 'pure-play' company this index is equal to one. Since a diversified company is expected to be less risky, the cost of equity is expected to be an increasing function of *HINDX*.

6.5.7 Additional Controls for Risk

Apart from reinsurance, other techniques of risk management such as derivatives and catastrophe bonds³³ (CAT bonds) also are used by insurers. Several studies, such as Hentschel and Smith (1997), Cummins, Grace and Phillips (1999), Cummins, Phillips and Smith (2001) have examined the use of derivatives by US-based insurers for hedging asset volatility, liquidity, and exchange-rate risks. Hardwick and Adams (1999) document the use of derivatives by UK-based life-insurers for the same reasons. These studies suggest that exposure to volatile cash outflows caused by liability lawsuits and property catastrophes along with the exposure to economic fluctuations (e.g., interest rate movements) on the asset side of their balance sheets motivates the purchase of derivatives by the property-

³³ Cummins, Doherty and Lo (2002, p. 559) define CAT bonds as financial instruments "...in which borrowers contract for some degree of debt forgiveness in the event of predefined catastrophe".

liability insurers. In light of the fact that reinsurance can also be used by the primary insurers to hedge against the cash-flow volatility caused by future liability lawsuits and/or property catastrophes, these studies hypothesise that the derivatives are used as a substitute to the reinsurance. However, Cummins, Phillips and Smith (2001, p. 81) conclude that the "...insurers with relatively low risk tolerance are likely to use more derivatives and more reinsurance." Therefore, their results suggest a complementary relation between the use of reinsurance and derivatives by the primary insurers. In the same vein, Cummins (2008, p. 23) opines that "...CAT bonds are not expected to replace reinsurance but to complement the reinsurance market by providing additional risk-bearing capacity".

Despite their growing popularity, to date, the use of derivatives has remained limited to only a minority of insurers. Prior studies indicate a substantial difference in the number of users of reinsurance and derivatives. For example, Cummins, Phillips, and Smith (1997) report that only 7% of the US based property-liability insurers used derivatives in 1994, while the use of reinsurance is much more widespread. Although an exact corresponding figure is unavailable in the case of the UK's non-life insurers, a similar proportion of companies is expected to use derivatives. Out of more than 4,000 firm-year observations used in this study only about 500 correspond to the use of derivatives. On the other hand, nearly 95% of the observations confirm the use of reinsurance. This lack of variability in derivatives data makes it unfeasible to introduce a variable representing use of derivatives in the regression analysis conducted in this study.

6.6 Model Specification

6.6.1 Decision to Reinsure

Having defined the dependent and explanatory variables, the next step is to specify the model to test the two proposed hypotheses reported previously in Chapter 4, section 4.4. To test the first hypothesis, which relates the cost of equity to the managerial decision to reinsure, the following model is specified:

$$COE_{it} = \beta REINID_{it} + \gamma LEV_{it} + \phi SIZE_{it} + \lambda CAP_{it} + \rho LIQ_{it} + \theta HINDX_{it} + \varepsilon_{it} \quad (6.7)$$

Equation (6.7) is similar (but not identical) to the models used by Botosan and Plumlee (2005), and Botosan et al. (2011) to compare the relative accuracy of the cost of equity estimates obtained using different techniques. The model in the equation (6.7) above is based on the idea that the risk undertaken by investors must be priced in the cost of equity, hence the factors that can affect this risk must be accounted for in the model. All the variables appearing in the equation (6.7) above are described in Table 6.1, while the last term ε_{it} in the equation (6.7) represents an error term that accounts for unobserved firm specific effects (e.g., variations in managerial quality) α_i , time specific shocks (e.g., macroeconomic changes) v_t and a random (white noise) error term η_{it} . That is:

$$\varepsilon_{it} = \alpha_i + v_t + \eta_{it} \quad (6.8)$$

In the presence of firm specific effects, the ordinary least squares estimator (OLS) is biased and inconsistent (Greene, 2003). For instance, firm-effects introduce a downward bias in estimates of standard errors. This downward bias in standard errors results in an upward bias in the magnitude of estimated t-statistics, which in turn leads to a statistical significance being assigned to variables that may not be significant (Greene, 2003). There is potential for the firm effects to be present in the dataset used in this study, hence it is required that the clustering of standard errors within firms is accounted for in regressions. Thus, to alleviate this concern the standard errors corrected for clustering within firms are used (Wooldridge, 2002).

There is, however, another possibility that there are some unobserved time specific factors that affect the relation between the variables entering the regression analysis. Insurance being a cyclical industry is prone to time specific events, which can lead to a correlation of error terms across the cross-section of firms in a given year. For example, in the aftermath of a major catastrophe, capital levels in the insurance industry are depleted and so the cost of capital, as well as premiums charged in the market rise. Again, OLS standard errors are biased downwards in the presence of time specific effects and thus they can be controlled by clustering the standard errors across time (Wooldridge, 2002). In case both types of shocks are present, then it is required that the standard errors used are robust to clustering across both cross-sectional and temporal dimensions of panel

dataset (Petersen, 2009). To ensure that the standard errors are robust to heteroskedasticity and autocorrelation, the current study uses the Newey and West (1987) estimation procedure which controls for arbitrary heteroskedasticity and autocorrelation. Moreover, year-dummies are used in the estimation to control for time specific effects.

6.6.2 Extent of Reinsurance

According to the second hypothesis put forward in Chapter 4 section 4.4, the relation between the cost of equity of insurance firms and the extent of reinsurance is expected to be non-linear. The extent of reinsurance for the purpose of testing the second hypothesis is defined as the reinsurance ratio (see Table 6.1). To capture the element of non-linearity, the square term of the reinsurance ratio is introduced into the equation. Such an approach is consistent with previous research such as Zou (2010), who uses the square of the level of corporate insurance purchased to account for non-linearity. Thus, to test the extent of the reinsurance hypothesis the following baseline model is specified:

$$COE_{it} = \beta_1 REINS_{it} + \beta_2 REINS_{it}^2 + \gamma LEV_{it} + \phi SIZE_{it} + \lambda CAP_{it} + \rho LIQ_{it} + \theta HINDX_{it} + \varepsilon_{it} \quad (6.9)$$

However, reinsurance is a key element of the capital structure of insurance companies, so there is potential for endogeneity in the specified model (Cole and McCullough, 2006). For example, a higher degree of corporate leverage can lead to a higher demand for reinsurance, which in turn can increase the underwriting capacity of the insurer leading to a further increase in leverage. Eventually this is likely to result in a higher cost of capital. To alleviate concerns about prospective endogeneity, an instrumental variable approach is also used in this study. An instrumental variable possesses the property that it is a good predictor of the endogenous variable, but is uncorrelated to the main dependent variable (Greene, 2003). Specifically, three instruments are used in the current study in the 'reinsurance volume model'. These are: 1) reserving errors from the previous year; 2) an indicator variable if the earnings of the firm are in the convex region of the corporate marginal rate of tax, and 3) the annual return on assets. The motivation for using these three instruments is covered in section 6.7 below.

6.6.3 Alternative Techniques for Non-linear Estimation

The reinsurance-volume decision model proposed in this study hypothesises a non-linear relation between the cost of equity and the extent of reinsurance. The current study uses a linear estimation model after transforming the original quadratic variable (REINS2) to account for the hypothesised non-linear relation. Apart from this method, there are a few other econometric techniques including spline regression, the dummy variable approach, time counters, intervention analysis, interrupted time series, and piecewise linear models that can be used for a non-linear estimation. The applicability of these techniques depends on the characteristics of the non-linear relation under investigation. For example, if a continuous variable appears to change its trajectory over time in response to some event or policy, then this change is either abrupt or smooth. If the dependent variable changes abruptly following a policy change, then an interrupted time series design (to capture intercept shifts) might be appropriate. However, if a gradual change in the dependent variable is encountered, then a spline model is preferable because of its ability to capture the smooth change of slope in joining two regression lines (before and after the event/policy change) without a break. Indeed Pindyck and Rubinfeld (1998) refer to spline regression models as “piecewise linear regression” because they effectively piece together two or more linear regressions. Marsh and Cormier (2002) explain that spline models are essentially dummy variable models subject to one or more continuity restrictions. They further explain that if the location of the knots is unknown then nonlinear least squares must be used adding to the complexity of the procedure. Not only this, the complexity of this procedure increases further when the number of knots is unknown. This is indeed the case in the current study as the point of inflection, and the number of these points is unknown. In view of this fact, a simpler linear estimation technique based on the linear transformation of quadratic variables is considered to be the best available technique.

6.7 Instrumental Variables and Implementation

An insurer that under-reserves is more likely to be financially distressed and so subject to a greater risk of bankruptcy. As reinsurance is a form of contingent

capital, other things being equal, a financially troubled insurer is thus more likely to use reinsurance than insurers who are in a sound financial condition. Indeed, Petroni (1992) provides evidence that there is a higher probability of under-reserving by financially distressed insurers in the US property-liability insurance industry. Cole and McCullough (2006, p. 174) also assert that, "...if an insurer has positive loss development, or has been under-reserving, then the insurer is likely to demand more reinsurance in an effort to mitigate potential financial constraint". Accordingly, it follows that reserving errors can, at least in part, explain the use of reinsurance, and therefore, a reserving error variable is a potential instrument for the extent of reinsurance. Moreover, the academic literature provides no evidence that a reserving error is directly related to the cost of equity, and so it has all the properties of a 'good instrument'. In this study, reserving errors are estimated using the KFS method developed in Kazenski, Feldhaus and Schneider (1992), scaled by reported capital resources are used as the measure for reserving errors³⁴. Further, the KFS method of estimating reserving errors is one of the most common methods of estimating reserving errors (Grace and Leverty, 2012). According to the KFS method, for an insurance firm 'i' reserving errors corresponding to the estimated losses in year 't', can be calculated 'n' years after year 't', using the following equation:

$$Reserve\ Error_{i,t} = Incurred\ Losses_{i,t} - Incurred\ Losses_{i,t+n} \quad (6.10)$$

Reserving errors calculated using the equation (6.10) above show the difference between the expected losses in a given year and the actual payments made corresponding to those losses in a future year. A negative error would then be evidence of under-reserving. Accordingly, the reserve error variable is expected to be negatively related to the demand for reinsurance. In this study, the errors are calculated one year in the future (i.e., n = 1). Hence, the inclusion of this variable results in the loss of one year of data (i.e., the latest year for which data are available for a particular firm), as the figures for future values of incurred losses corresponding to the latest year were not available at the time of analysis. Therefore, without the loss of generality, the ratio of reserving error to reported

³⁴ Refer to Appendix B for a detailed explanation of the KFS method used in the present study to calculate the reserving errors.

capital resources, denoted $RESERR_{it}$, is used as an instrument for the reinsurance ratio.

Corporate tax has also been suggested in the academic finance literature as a determinant of corporate hedging. According to Garven and Lamm-Tennant (2003) reinsurance facilitates investment in tax-exempt assets, viz. municipal bonds, by reducing the probability of large unexpected losses. Smith and Stulz (1985) suggest that in a progressive tax regime (such as in the UK) corporate hedging enables firms to reduce their expected tax liabilities. By showing that reinsurance reduces fluctuations in an insurer's earnings leading to a reduction in tax liability, Mayers and Smith (1990) provide empirical evidence in support of this hypothesis. Therefore, taxable income in the convex region of the tax schedule can be used as an indicator for the purchase of reinsurance. Consequently, this study uses an indicator variable, named CTAX, which takes value 1 if the earnings before tax for an insurer fall in the convex region of the tax schedule, and 0 otherwise. As in the case of reserving errors, this variable is not directly related to the cost of equity of an insurance firm; nonetheless, it is a reasonable predictor for reinsurance purchases, and so a valid instrument variable that can be used in the present study.

The return on assets (ROA) is also a potentially important consideration in determining the extent of reinsurance purchased by a primary insurer. An insurance firm with a stable and positive ROA is less likely than other insurance firms to face financial distress/bankruptcy, as it is better able to absorb losses arising from low-frequency but high-severity events. Therefore, it is expected that a more profitable insurer is less likely to reinsure in order to maintain its capital adequacy than a less profitable insurer. Following Cole and McCullough (2006), ROA thus enters the regression analysis as the third instrumental variable for the extent of reinsurance purchased by an insurer. Like the previous two instruments, prior research has not established any direct causal relation between ROA and the cost of equity of an insurer.

Using these three instrumental variables, namely, reserving errors, indicator variable indicating taxable earnings in convex region of the tax schedule, and

return on assets, along with other variables from the structural equation (6.9), the ‘reinsurance volume model’ can now be expressed as:

$$REINS_{it} = \delta_1 RESERR_{it} + \delta_2 CTAX_{it} + \delta_3 ROA_{it} + \delta_4 LEV_{it} + \delta_5 SIZE_{it} + \delta_6 CAP_{it} + \delta_7 LIQ_{it} + \delta_8 HINDX_{it} + u_{it} \quad (6.11)$$

The last term u_{it} of the reduced form equation (6.11) denotes the error term of the first-stage IV estimator. Similar to the structural equation (6.9), to control for downward biased standard errors resulting from heteroskedasticity and autocorrelation, the Newey and West (1987) estimation procedure is employed in the first-stage regressions. Table 6.2 below summarises the three IVs used in this study:

Table 6.2: Instrumental Variables

This table defines variables used in testing the hypotheses postulated in this study. All the variables pertain to the values for firm ‘i’ in year ‘t’.

Name	Denotes	Definition
RESERR _{it}	Reserve Errors	Reserve errors estimated using the KFS (Kazenski et al., 1992) method and scaled by reported capital resources
CTAX _{it}	Convex Tax Liability	Indicator variable taking value 1 if earnings are in convex region of the tax schedule, 0 otherwise
ROA _{it}	Return on Assets	Sum of underwriting income and investment income divided by total reported assets

The instrumental variable (IV) approach followed here utilises a two stage least squares (2SLS) estimator. Wooldridge (2002) explains that if instruments used in the reduced form equation and exogenous regressors in the structural equation are expected to be uncorrelated with the error term of the structural equation, then the 2SLS estimator is the most efficient among the class of IV estimators. As mentioned above, the instruments employed in the present study are so chosen that they can be assumed to be independent of the equity cost of capital. Hence it is reasonable to expect that the IVs used in this study along with exogenous variables from equation (6.9) are indeed independent of the error term in the equation (6.9). As the name suggests, the 2SLS estimator involves two stages of estimation. In the context of the current study, the value of the endogenous variable, $REINS_{it}$, was predicted using the reduced form equation (6.11). The

predicted values so obtained were then inserted in the structural equation 6.9 to estimate the effect of the extent of reinsurance purchased on the cost of equity of an insurer. As has been mentioned in the preceding section 6.6, both the stages of estimation employ standard errors that are robust to heteroskedasticity and autocorrelation. Moreover, the estimation procedure controls for time specific effects by including year-dummies in the regression analysis.

6.8 Conclusion

This chapter started by providing a discussion of the prospective research methods and an explanation of the reasons for choosing the statistical methods used. The next section described the sources of data and the sample selection process. Following this, two models were specified to test the two main research hypotheses put forward previously in Chapter 4, along with a detailed discussion of the motivation for, and definition of, the variables used in the regression analysis. Further, to overcome any concern of potential endogeneity a 2SLS IV technique is deemed to be an optimal solution. Three suitable instruments (i.e., reserve errors, tax convexity, and return on assets) for the key explanatory variable, the reinsurance ratio, are put forward along with a discussion of the implementation strategy using a 2SLS approach. The empirical results arising from the multivariate analysis are now discussed in Chapter 7 of this thesis.

CHAPTER 7. EMPIRICAL RESULTS

7.1 Introduction

Risk management in general, and reinsurance in particular, as a value-added activity have been examined using various theories in the literature as reviewed in Chapter 3. This review facilitated the formulation of two hypotheses put forward in Chapter 4 of the thesis. These hypotheses examine the relationship between the cost of equity and reinsurance purchased by an insurer. Using the statistical procedures described in Chapter 6, these hypotheses are tested and the results reported in this chapter. The current chapter compiles these results along with the relevant statistics pertaining to the estimation sample used in the study. Specifically, univariate, bivariate, and multivariate analyses are presented using descriptive (summary) statistics, correlation analyses, and regression analyses, respectively.

7.2 Descriptive Statistics

According to the sample selection criteria detailed in Chapter 6, section 6.3, the estimation sample used in this study contains 386 firms observed over 26 years (1985 to 2010) resulting in 4,916 firm-years of observations with which to conduct the statistical analysis. The univariate statistics pertaining to continuous variables in this sample are presented in Table 7.1. This table reports the mean, median, standard deviation, minimum and maximum values of each variable. Moreover, the number of available observations (N), number of individual firms to which these data belong (n), and the average time period for which each of the firms was observed (T) are also reported in the last column of Table 7.1. This table also decomposes the standard deviation, minimum and maximum values of each of the variables at overall, between and within level. The overall statistic takes account of all the observations available for a particular variable without segregating the

Table 7.1: Descriptive Statistics

Panel A: Descriptive Statistics								
Variable	Unit/Scale	Level	Mean	Median	Std. Dev.	Min	Max	Observations
<i>RP</i>	Per cent	overall	5.65	5.67	0.53	4.63	6.91	N : 4916
		between			0.52	4.63	6.90	n : 386
		within			0.20	4.52	7.54	T : 12.74
<i>RP_CM</i>	Per cent	overall	5.49	5.49	0.22	4.96	5.99	N : 4916
		between			0.22	4.96	5.99	n : 386
		within			0.07	5.01	6.06	T : 12.74
<i>REINS</i>	Ratio	overall	0.32	0.27	0.26	0.00	1.00	N : 4629
		between			0.24	0.00	1.00	n : 367
		within			0.14	-0.34	1.18	T : 12.61
<i>REINS</i> ²	Ratio	overall	0.17	0.07	0.22	0.00	1.00	N : 4629
		between			0.21	0.00	1.00	n : 367
		within			0.13	-0.44	1.09	T : 12.61
<i>LEV</i>	Ratio	overall	0.24	0.13	0.44	0.00	14.50	N : 4916
		between			0.33	0.00	4.09	n : 386
		within			0.34	-3.85	10.66	T : 12.74
<i>CAP</i>	Ratio	overall	0.59	0.73	3.37	-231.50	1.00	N : 4916
		between			0.90	-15.63	0.99	n : 386
		within			3.24	-215.28	17.19	T : 12.74
<i>LIQ</i>	Ratio	overall	7.61	1.12	87.12	0.00	4985.50	N : 4916
		between			44.76	0.01	562.35	n : 386
		within			82.62	-459.04	4726.02	T : 12.74
<i>SIZE</i>	Logarithm	overall	11.05	10.97	1.95	5.70	16.62	N : 4916
		between			1.84	6.54	16.39	n : 386
		within			0.83	6.28	15.21	T : 12.74
<i>HINDX</i>	Ratio	overall	0.64	0.59	0.27	0.16	1.00	N : 4916
		between			0.25	0.22	1.00	n : 386
		within			0.13	0.06	1.23	T : 12.74
<i>ROA</i>	Ratio	overall	0.04	0.03	0.14	-0.82	2.85	N : 4916
		between			0.12	-0.54	1.57	n : 386
		within			0.09	-0.69	1.32	T : 12.74
<i>RESERR</i>	Ratio	overall	-0.03	0.01	1.79	-100.37	9.07	N : 3314
		between			0.82	-11.30	1.01	n : 280
		within			1.71	-93.09	8.51	T : 11.84

Panel B: Indicator Variables						
Variable	Metric	Represents	Value	Frequency	Percent	Firms
<i>REINSID</i>	Identifier	Reinsurance not used	0	287	5.84	77
		Reinsurance used	1	4,629	94.16	367
		Total sample		4,916	100	386
<i>CTAX</i>	Identifier	Earnings not in convex region	0	4,088	83.16	379
		Earnings in convex region	1	828	16.84	232
		Total Sample		4,916	100	386

Panel C: Summary Statistics of Winsorized Variables

Variable	Unit/Scale	Level	Mean	Median	Std. Dev.	Min	Max	Observations
<i>WREINS</i>	Ratio	overall	0.29	0.27	0.20	0.00	0.55	N : 4629
		between			0.18	0.00	0.55	n : 367
		within			0.11	-0.18	0.75	T : 12.61
<i>WREINS</i> ²	Ratio	overall	0.12	0.07	0.12	0.00	0.31	N : 4629
		between			0.10	0.00	0.31	n : 367
		within			0.07	-0.15	0.40	T : 12.61
<i>WLEV</i>	Ratio	overall	0.19	0.13	0.16	0.03	0.53	N : 4916
		between			0.12	0.03	0.53	n : 386
		within			0.11	-0.17	0.61	T : 12.74
<i>WCAP</i>	Ratio	overall	0.69	0.73	0.20	0.21	1.00	N : 4916
		between			0.16	0.21	0.99	n : 386
		within			0.15	0.03	1.17	T : 12.74
<i>WLIQ</i>	Ratio	overall	2.49	1.12	3.43	0.00	13.30	N : 4916
		between			2.94	0.01	13.30	n : 386
		within			2.45	-6.59	14.58	T : 12.74
<i>WRESERR</i>	Ratio	overall	0.00	0.01	0.20	-0.98	0.87	N : 3314
		between			0.14	-0.98	0.87	n : 280
		within			0.17	-1.02	1.13	T : 11.84

(Source: Research Data). Summary statistics for the panel of 386 firms present in the UK's non-life insurance market are presented in this table. At least two consecutive years of observations are available for each firm in this sample over the study period of 1985 – 2010. Panel B reports the summary statistics of indicator variables used in the study, while Panel C reports summary statistics of variables after winsorization.

Notes: *RP* represents as a percentage the cost of equity calculated using RL model. *RP_CM* represents as a percentage the cost of equity calculated using CAPM. *REINS* represents the reinsurance ratio defined as the ratio of premiums ceded to gross premiums written in a year. *REINS*² is the square of reinsurance ratio. *LEV* denotes financial leverage, which is calculated as the difference between total assets and policyholders' surplus divided by total assets. *CAP* denotes an insurer's capacity to grow, calculated as the difference between capital resources and capital resource requirements scaled by capital resources. *LIQ* is the liquidity level calculated as the ratio of cash to claims incurred in a given year. *SIZE* is the natural log of total reported assets by a firm. *HINDEX* measures product diversification using the Herfindahl Index. *ROA* denotes return on assets calculated as the earnings before tax divided by total assets. *RESERR* is the reserving error calculated using KFS method. *REINSID* is an indicator variable which takes value 1 if an insurer uses reinsurance and 0 otherwise. *CTAX* is an indicator variable taking value 1 if earnings before tax are in convex region and 0 otherwise. *WREINS* is the reinsurance ratio winsorized at 20th percentile on the right tail. *WREINS*² is the square of the reinsurance ratio after winsorization. *WLEV* denotes financial leverage winsorized at 10th percentile on both tails. *WCAP* is the growth capacity winsorized at 5th percentile on the left tail. *WLIQ* is the liquidity winsorized at 5th percentile on the left tail. *WRESERR* is the reserving errors winsorized at 1st percentile on both tails.

values either across time or firms. The between statistic is the mean of the firm-level average of a particular statistic, which is calculated over the number of firms (n in Table 7.1) present in the sample corresponding to a given variable. On the

other hand, the within statistic, like the overall statistic is calculated over all the available observations (N in Table 7.1). The calculation of the within statistic involves adding the overall mean to each of the observations while simultaneously subtracting the corresponding firm level mean. Thus, the 'between' standard deviation provides information about the expected deviation from the overall mean across a randomly selected sample of firms in any given year, whereas the 'within' standard deviation estimates the expected deviation from the firm-specific mean for an individual firm across different time periods.

The first variable listed in Table 7.1 is the equity risk premium, *RP*, estimated using the R-L model. For each firm, this variable denotes the excess return over the risk-free rate demanded by investors to invest in the firm. The equity risk premium for the firms in the estimation sample ranges from a minimum of 4.63% to a maximum of 6.91% and a mean value of 5.65%. This variable is homogeneously distributed over the entire sample as the median value of 5.67% and is very close to the overall mean indicating a low level of skewness. A modest value of the overall standard deviation (0.53%) relative to the mean suggests that the variable shows a low variability around the mean. Since the between-firm standard deviation is 0.52%, the cross-firm variation of *RP* is also low, reflecting similar business risks within the UK's non-life insurance industry. The cross-firm variation is, however, much higher than the standard deviation of 0.20% around the firm-specific mean. The difference in cross-firm and within-firm variations suggests that most of the firms strive to attain a target capital structure such that there is little variation in the equity risk premium over the life-time of the firm.

The second variable listed in Table 7.1 is the reinsurance ratio, *REINS*, which ranges from a minimum of 0 to maximum of 1. A smaller value of this ratio indicates a lesser volume of premiums ceded relative to gross premiums written at the total business level. A very high value of the ratio is equivalent to a very high cession rate, indicative of an insurer either in run-off or in financial distress. Given the sampling technique employed, most of the firms in the estimation sample are expected to be going concerns, resulting in moderate values of reinsurance ratio. Nonetheless, there are a few insurers left in the estimation sample that have large values of reinsurance ratio in comparison to the mean and median values of 0.32 and 0.26 respectively. The uneven distribution of this variable is also reflected in a

lower overall mean relative to the average (0.5) of minimum and maximum values. Such a distribution pattern arises because both the underlying variables used in calculating this ratio, namely the premiums ceded and gross premiums written, are themselves distributed log-normally. Similar to the equity risk premium, the reinsurance ratio shows a higher variation across the cross-section of firms in a given year compared to the within-firm variation during the study period. The 367 firms observed for approximately 13 years on average give rise to 4,629 observations available for this variable. The reinsurance ratio being strictly positive, the square of this variable follows a distribution similar to the original variable with a mean of 0.17 and a median of 0.07.

As is noted above, a high value of reinsurance ratio is symptomatic of an insurer in financial distress, therefore to overcome the confounding effects of extreme cession rates, winsorized values of the reinsurance ratio are used in the regression analysis. Variable *REINS* has been winsorized at 20th percentile on the right tail to obtain variable *WREINS* reported in Panel C of Table 7.1. Winsorization results in a maximum reinsurance ratio of 0.55, which brings the mean and the median values closer to each other at 0.28 and 0.26 respectively. Although winsorization reduces the potentially confounding effects of extreme values, the change observed in the variation of reinsurance ratio is modest (from standard deviation of 0.26 for un-winsorized variable to 0.20 for winsorized variable), making the winsorized variable suitable for conducting the regression analysis and drawing inferences.

Leverage, denoted by *LEV*, is the next variable reported in Table 7.1. In the estimation sample, leverage ranges from 0 to 14.5. This suggests the presence of both the new entrants, and very highly leveraged insurance firms in the estimation sample. The overall standard deviation at 0.44 is almost double the mean of 0.24 indicating substantial variation in leverage within the estimation sample. The within-firm standard deviation of leverage at 0.34 is approximately equal to the between-firm variation with a standard deviation at 0.33. A higher value of the overall standard deviation relative to the within-standard deviation, however, indicates that UK non-life insurers have strived to achieve a stable capital structure and risk profile over time. A higher mean (0.24) than the median (0.13) shows that the distribution of this variable is positively skewed. Transformed values of

leverage obtained by winsorizing at the 10th percentile at both tails, denoted by *WLEV* in Panel C of Table 7.1, are used in the regression analysis, to again avoid the confounding effect of extreme values (outliers) of this variable. Post-winsorization, leverage has a mean of 0.19, which is closer to the median with substantial changes in the minimum and maximum values.

Since the enactment of the Insurance Companies Act (1974), regulations in the UK's non-life insurance sector mandate insurers to maintain a minimum level of capital resources commensurate with the risks underwritten by an insurer. Therefore, the difference between capital resources available to the insurer and the minimum level of capital required to remain a going concern can be used to gauge both the capacity to grow, and the riskiness of the insurance business. Variable *CAP* listed in Table 7.1 captures this feature of the risk of an insurer. As explained in section 6.5.4, this variable is calculated as the difference of capital resources and capital resource requirements, scaled by capital resources. Large overall and within-firm variations for this variable are observed in the estimation sample with overall and within-standard deviations of 3.37 and 3.24 respectively. Both these variations are large with respect to the mean and median values of 0.59 and 0.73 respectively. Minimum values of *CAP* at overall, between and within-firm levels (231.50, 15.63 and 215.28) have an extremely large magnitude in comparison to the overall mean. An insurer with a negative difference between capital resources and minimum capital resource requirements will be disallowed by the regulator from underwriting any new business. Therefore, to remedy the estimation sample from the implausible values of growth capacity, *CAP* is winsorized at the 5th percentile on the left tail to force all the values of *CAP* to be representative of going concerns. This operation places a lower bound of 0.21 on *CAP*, and raises the mean to 0.69 from 0.59.

The variable *SIZE* in Table 7.1 is calculated as the natural logarithm of total assets reported by an insurer in a year. Such a transformation serves two purposes. First, since the total assets of a firm in an industry are log-normally distributed, the logarithmic transformation results in a 'near' normally distributed variable. Second, the scaling of total assets is achieved by this transform, which makes the results from econometric analysis easy to interpret. The size of the firms in the estimation sample, measured using the log of monetary value of total assets, ranges from

5.70 (approximately £0.3 million) to 16.62 (£16.5 billion). Interestingly, the between and within-standard deviations in size are of similar magnitude at 6.54 and 6.27, indicating that the variation in firm size across firms in a given year is likely to be of the same scale as the variation in the size of a firm over the study period. The well behaved distribution of this variable is reflected in similar mean and median values at 11.04 and 10.61 respectively. The overall standard deviation of this variable at 1.95 is close in magnitude to the between-standard deviation of 1.81, confirming that the overall variation in size is driven by a variation in firm size across the panel.

Liquidity is another important variable used in this study, denoted by *LIQ*, in Table 7.1. This variable reflects the adequacy of an insurer's liquid assets to pay the claims incurred in any given year. This measure of liquidity indicates a large variation in the liquidity levels, both over time for a firm, and across the cross-section in a year. The mean and median values, at 6.65 and 1.10 respectively, are relatively small in comparison to the standard deviation of 82.08. Moreover, there is substantial skew in the distribution as there is a long right-hand tail, indicating the presence of outliers in the data as confirmed by the huge difference between the minimum and maximum values of 0 and 4985.5 respectively. The extreme value in this case is so large that it is approximately 50 standard deviations away from the mean on right tail. Therefore, to eliminate the confounding effect of outliers, *LIQ* is winsorized at the 5th percentile (13.3) level on the right tail. The summary statistics of liquidity after winsorization (denoted by *WLIQ*) are presented in Panel C of Table 7.1. Post winsorization, liquidity becomes much more evenly distributed with a smaller mean of 2.42 and comparable standard deviations of 3.35, 2.59 and 2.38 at overall, between and within levels respectively.

Product diversification is denoted in Table 7.1 as *HINDX* which corresponds to the annual value of the Herfindahl index calculated for each firm. About 38% (146 out of 386) of the firms in the estimation sample conducted their business as mono-line companies (Herfindahl index of 1), for at least one year during the study period. Similar, but relatively large magnitudes of mean (0.64) and median (0.59) indicate that less diversified insurers are more prevalent in the estimation sample. In other words, insurers operating in the UK non-life insurance market tend to specialise in a few niche lines of business rather than diversifying their business

across all the product-markets at their disposal. Further, a higher between-standard deviation (0.25) than within-standard deviation (0.13) suggests that product diversification at the firm level shows little variation over the study period. However, there are few well diversified insurers in the estimation sample with the minimum value of *HINDX* being 0.15.

As mentioned in the previous chapter, reserving errors have been used in this study as an instrument for use of reinsurance. Unlike other variables, observations for this variable are available only until the year 2009 (as explained in section 6.7 of Chapter 6). There is substantial variation in the values of reserving errors with minimum and maximum values being -100.37 and 9.07 respectively. A reserving error of 9.07 means that the difference between the reserves for the estimated losses and actual losses was 9.07 times the admissible capital resources reported by the insurer. These are extreme values when compared to the mean and median values respectively of 0.06 and 0.03. Given these observations, it is unsurprising that the standard deviation is large at 1.35 as compared to the reported measures of central tendency. Therefore to alleviate the confounding effects of extreme values of this variable in the first stage of IV regressions, the values of reserving error are winsorized at the 1st percentile on both the tails. After winsorization, the reserving errors range from a minimum of -0.98 to a maximum of 0.87.

Return on assets, denoted as *ROA* in Table 7.1, is a variable which has also been used as an instrument in the IV estimations, ranges from a minimum of -0.82 to a maximum of 2.85. A large variation in the values of *ROA* is evidenced by a high standard deviation of 0.14 relative to the mean of 0.04. This is one of the evenly distributed variables in this study as the median value of 0.03 is close to the mean value of 0.04. Moderate values of the mean and median also confirm that large returns are not very common in the UK's non-life insurance market with risk-pooling (i.e., economies of scale and scope) being the key driver of profits.

Panel B of Table 7.1 reports two indicator variables that have been used in this study. The first variable indicates the use of reinsurance by an insurer, and shows that nearly 95% of the observations correspond to the use of reinsurance by the insurers. The mean value of equity risk premium at 6.12% for non-users of

reinsurance is higher than the corresponding value of 5.62% for the users of reinsurance. Similarly the average value of the Herfindahl index at 0.93 is higher for non-users than for users (0.62) of reinsurance.

As noted in section 6.7 of Chapter 6, annual earnings before tax falling in the convex region of the tax schedule have been used as one of the predictors of the purchase of reinsurance. The variable *CTAX* in Panel B of Table 7.1 shows that nearly 17% of the observations in the estimation sample correspond to earnings within the convex region of the tax schedule. The mean value of the reinsurance ratio for these observations is 0.36, which is higher than the mean of 0.31 for the remaining observations.

Having discussed the univariate statistics in some detail, to further discuss the simultaneous interactions between the variables entering the regression analysis, it is important to consider the correlations between these variables. Therefore, the following section presents pairwise correlations between the key variables used in this study.

7.3 Bivariate Results

Table 7.2 reports the pairwise correlation coefficients between the two alternative sets of estimates of the cost of equity (dependent variable) and the explanatory variables used in the study. Two correlation analyses, namely the parametric Pearson Correlation and the non-parametric Spearman Rank Correlation, are reported in this table. Both types of correlations reveal that there is a statistically significant ($p \leq 0.01$, two-tailed) negative correlation between the cost of equity and the decision to reinsure. A statistically significant positive association is also found between the extent of reinsurance and the cost of equity. These results however do not take into account the non-linear relation between the cost of equity and the volume of reinsurance purchased, therefore are likely to be biased by large values of reinsurance ratio. Increases in leverage and liquidity correspond to increases in the cost of equity, as shown by statistically significant positive correlations between the equity risk premium and these variables. Since an increase in premiums written leads to an increase in both the leverage and cash assets of the

Table 7.2: Correlation Matrix for Risk Premium

Variable	Pearson Correlation		Spearman Correlation	
	<i>RP</i>	<i>RP_CM</i>	<i>RP</i>	<i>RP_CM</i>
<i>RP_CM</i>	0.58***	1	0.52***	1
<i>REINSID</i>	-0.20***	-0.27***	-0.18***	-0.28***
<i>REINS</i>	0.09***	-0.01	0.14***	-0.03***
<i>REINS</i> ²	0.08***	-0.00	0.14***	-0.03***
<i>LEV</i>	0.05***	0.06***	0.07***	0.04***
<i>CAP</i>	-0.02*	0.00	-0.07***	-0.02
<i>LIQ</i>	0.02	0.02**	0.14***	0.17***
<i>SIZE</i>	-0.07***	-0.13***	-0.10***	-0.14***
<i>HINDX</i>	0.17***	0.18***	0.16***	0.26***
<i>ROA</i>	0.01	0.13***	0.00	0.18***
<i>RESERR</i>	-0.00	-0.00	-0.08***	-0.04***
<i>CTAX</i>	0.01	0.05***	0.02*	0.07***
<i>WREINS</i>	0.10***	-0.00	0.15***	-0.03***
<i>WREINS</i> ²	0.12***	-0.00	0.15***	-0.03***
<i>WLEV</i>	0.07***	0.08***	0.08***	0.04***
<i>WCAP</i>	-0.09***	-0.01	-0.07***	-0.02
<i>WLIQ</i>	0.10***	0.16***	0.14***	0.17***
<i>WRESERR</i>	-0.03*	-0.01	-0.08***	-0.04***

(Source: Research Data). Pairwise correlations among various regressors used in this study have been presented in this table. Both Spearman's Rank Correlation coefficients and the Pearson's Correlation Coefficients have been reported. Superscripts *, ** and *** denote statistical significance at 10%, 5% and 1% level respectively (two-tail).

Notes: *RP* represents as a percentage the cost of equity calculated using the RL model. *RP_CM* represents as a percentage the cost of equity calculated using CAPM. *REINS* represents the reinsurance ratio defined as the ratio of premiums ceded to gross premiums written in a year. *REINS*² is the square of reinsurance ratio. *LEV* denotes financial leverage, which is calculated as the difference between total assets and policyholders' surplus divided by total assets. *CAP* denotes an insurer's capacity to grow, calculated as the difference between capital resources and capital resource requirements scaled by capital resources. *LIQ* is the liquidity level calculated as the ratio of cash to claims incurred in a given year. *SIZE* is the natural log of total reported assets by a firm. *HINDX* measures product diversification using the Herfindahl Index. *ROA* denotes the return on assets calculated as the earnings before tax divided by total assets. *RESERR* is the reserving error calculated using the KFS method. *REINSID* is an indicator variable which takes the value 1 if an insurer uses reinsurance and 0 otherwise. *CTAX* is an indicator variable taking the value 1 if earnings before tax are in a convex region and 0 otherwise. *WREINS* is the reinsurance ratio winsorized at the 20th percentile on the right tail. *WREINS*² is the square of the reinsurance ratio after winsorization. *WLEV* denotes financial leverage winsorized at the 10th percentile on both tails. *WCAP* is the growth capacity winsorized at the 5th percentile on the left tail. *WLIQ* is the liquidity winsorized at the 5th percentile on the left tail. *WRESERR* is the reserving errors winsorized at 1st percentile on both tails.

company, it is likely that there would be a positive correlation between the cost of equity and measures of leverage and liquidity. As expected, the correlation between equity risk premium and growth capacity as well as size is negative and statistically significant ($p \leq 0.01$, two-tailed). This is so because insurers with a higher capacity to underwrite new business are likely to be less financially distressed than low capacity insurance firms leading to a relatively lower cost of equity. Similarly, larger insurers are generally more diversified than smaller entities and so more capable of recapitalising through capital markets in the aftermath of unexpectedly severe loss events. Since the Herfindahl index is an inverse measure of product-diversification, in accordance with expectations, the equity risk premium is positively related to *HINDX*. Table 7.2 also shows that the equity risk premium is not highly correlated with the IVs used for predicting the reinsurance ratio, verifying their appropriateness in the context of this study.

Table 7.3 presents the pairwise correlation coefficients between explanatory as well as the IVs used in the study. The upper triangle of this matrix presents the Spearman's rank correlation coefficients, whereas the lower triangle reports the Pearson's correlation coefficients. The reinsurance ratio denoted by *REINS* in Table 7.3 is highly correlated with its winsorized value as well as with its squared value. This is expected as the reinsurance ratio cannot be negative (the insurer can either decide to purchase or not to purchase reinsurance). However, this raises the potential for multicollinearity, which in this case is unavoidable given the postulated convex relation between the cost of the equity and reinsurance ratio. Further, leverage and reinsurance are expected to be correlated since they are both elements of the capital structure of an insurer. This is reflected in a moderately high, positive and statistically significant correlation coefficient between the leverage and reinsurance ratio³⁵. Growth capacity too is positively correlated with the reinsurance ratio as purchasing reinsurance can increase the underwriting capacity of an insurer. For an insurer, liquidity is a function of premiums underwritten, which leads to an increase in leverage. A highly leveraged insurer is likely to purchase more reinsurance, hence *LIQ*, similar to *LEV*, is also positively correlated with the reinsurance ratio. Due to the higher capacity of larger

³⁵ This again poses a concern of multicollinearity in the estimation. Therefore, robustness checks are reported in subsequent sections to alleviate these concerns.

Table 7.3: Correlation between Explanatory Variables

Pairwise correlations among various regressors used in this study have been presented in this table. The upper-triangle reports the Spearman's Rank Correlation coefficients, whereas the lower triangle reports the Pearson's Correlation Coefficients. Panel A reports the correlation coefficients among variables before winsorization and Panel B reports the same after winsorization. Superscripts *, ** and *** denote statistical significance at 10%, 5% and 1% level (two-tail) respectively.

Panel A: Correlation Coefficients before Winsorization

	<i>REINSID</i>	<i>REINS</i>	<i>REINS</i> ²	<i>LEV</i>	<i>CAP</i>	<i>LIQ</i>	<i>SIZE</i>	<i>HINDX</i>	<i>ROA</i>	<i>RESERR</i>	<i>CTAX</i>
<i>REINSID</i>	1			0.10***	0.06***	-0.09***	0.19***	-0.27***	-0.15***	0.00	-0.05***
<i>REINS</i>		1	1***	0.39***	0.08***	0.27***	-0.09***	-0.21***	-0.15***	-0.09***	0.06***
<i>REINS</i> ²		0.95***	1	0.39***	0.08***	0.27***	-0.09***	-0.21***	-0.15***	-0.09***	0.06***
<i>LEV</i>	-0.00	0.36***	0.39***	1	-0.12***	0.13***	-0.00	-0.14***	0.08***	0.01	0.00
<i>CAP</i>	-0.00	0.00	0.00	-0.00	1	0.22***	-0.03***	-0.01	0.21***	-0.02	0.11***
<i>LIQ</i>	-0.04***	0.07***	0.08***	0.01	0.00	1	-0.40***	0.16***	0.16***	-0.00	0.21***
<i>SIZE</i>	0.19***	-0.11***	-0.11***	-0.03**	0.02*	-0.04***	1	-0.39***	-0.10***	0.10***	-0.36***
<i>HINDX</i>	-0.26***	-0.17***	-0.11***	-0.00	0.00	0.03**	-0.39***	1	0.14***	-0.00	0.11***
<i>ROA</i>	-0.19***	-0.08***	-0.05***	0.06***	0.04***	-0.00	-0.09***	0.12***	1	0.16***	0.15***
<i>RESERR</i>	-0.00	-0.01	-0.01	-0.01	0.68***	0.00	0.01	0.02	0.06***	1	-0.02
<i>CTAX</i>	-0.05***	0.06***	0.06***	0.04***	0.01	0.03**	-0.34***	0.10***	0.08***	0.00	1

Panel B: Correlation Coefficients after Winsorization

	<i>REINSID</i>	<i>WREINS</i>	<i>WREINS</i> ²	<i>WLEV</i>	<i>WCAP</i>	<i>WLIQ</i>	<i>SIZE</i>	<i>HINDX</i>	<i>ROA</i>	<i>WRESERR</i>	<i>CTAX</i>
<i>REINSID</i>	1			0.10***	0.06***	-0.09***	0.19***	-0.27***	-0.15***	0.00	-0.05***
<i>WREINS</i>		1	1***	0.39***	0.08***	0.26***	-0.09***	-0.21***	-0.15***	-0.09***	0.05***
<i>WREINS</i> ²		0.97***	1	0.39***	0.08***	0.26***	-0.09***	-0.21***	-0.15***	-0.09***	0.05***
<i>WLEV</i>	0.09***	0.39***	0.42***	1	-0.12***	0.13***	-0.00	-0.14***	0.08***	0.01	0.00
<i>WCAP</i>	0.07***	0.06***	0.04***	-0.11***	1	0.22***	-0.03***	-0.01	0.21***	-0.02	0.11***
<i>WLIQ</i>	-0.15***	0.19***	0.21***	0.14***	0.19***	1	-0.40***	0.16***	0.16***	-0.00	0.21***
<i>SIZE</i>	0.19***	-0.11***	-0.13***	-0.02*	0.03**	-0.30***	1	-0.39***	-0.10***	0.10***	-0.36***
<i>HINDX</i>	-0.26***	-0.20***	-0.15***	-0.08***	-0.03**	0.15***	-0.39***	1	0.14***	-0.00	0.11***
<i>ROA</i>	-0.19***	-0.09***	-0.08***	0.10***	0.12***	0.14***	-0.09***	0.12***	1	0.16***	0.15***
<i>WRESERR</i>	-0.00	-0.06***	-0.05***	-0.01	0.03**	0.02	0.07***	0.00	0.10***	1	-0.02
<i>CTAX</i>	-0.05***	0.06***	0.06***	0.02	0.09***	0.18***	-0.34***	0.10***	0.08***	-0.00	1

(Source: Research Data).

Notes: *COE* represents as a percentage the cost of equity calculated using RL model. *COE* represents as a percentage the cost of equity calculated using CAPM. *REINS* represents the reinsurance ratio defined as the ratio of premiums ceded to gross premiums written in a year. *REINS*² is the square of reinsurance ratio. *LEV* denotes financial leverage, which is calculated as the difference between total assets and policyholders' surplus divided by total assets. *CAP* denotes an insurer's capacity to grow, calculated as the difference between capital resources and capital resource requirements scaled by capital resources. *LIQ* is the liquidity level calculated as the ratio of cash to claims incurred in a given year. *SIZE* is the natural log of total reported assets by a firm. *HINDX* measures product diversification using the Herfindahl Index. *ROA* denotes return on assets calculated as the earnings before tax divided by total assets. *RESERR* is the reserving error calculated using the KFS method. *REINSID* is an indicator variable which takes the value 1 if an insurer uses reinsurance and 0 otherwise. *CTAX* is an indicator variable taking value 1 if earnings before tax are in a convex region and 0 otherwise. *WREINS* is the reinsurance ratio winsorized at 20th percentile on the right tail. *WREINS*² is the square of the reinsurance ratio after winsorization. *WLEV* denotes financial leverage winsorized at 10th percentile on both tails. *WCAP* is the growth capacity winsorized at 5th percentile on the left tail. *WLIQ* is the liquidity winsorized at 5th percentile on the left tail. *WRESERR* is the reserving errors winsorized at 1st percentile on both tails.

insurers to absorb losses, they tend to purchase fewer amounts of reinsurance than smaller entities, which is reflected in the negative correlation between firm size and reinsurance ratio. Similarly, the negative correlation between the reinsurance ratio and *HINDX* shows that less diversified insurers are likely to demand lesser reinsurance, probably because they have greater expertise in underwriting niche classes of risks. All three instruments used for predicting reinsurance ratio, namely, *ROA*, *RESERR* and *CTAX*, are significantly correlated with the reinsurance ratio as shown by the Spearman rank correlation coefficient. On the other hand, only *RESERR* and *CTAX* have statistically significant Pearson's correlation coefficient with the reinsurance ratio.

Leverage is negatively correlated with the winsorized values of growth capacity of an insurer, which is in accordance with expectations, as an increase in leverage will result in the reduction in capacity to underwrite new business. Leverage is negatively correlated to firm size as well; yet the magnitude of correlation is small. Less diversified insurers tend to be more highly leveraged, as shown by the negative correlation between *HINDX* and leverage. Interestingly, a significant positive correlation between the winsorized values of reserving errors and leverage, namely *WRESERR* and *WLEV*, suggests that highly leveraged insurers tend to over-reserve in comparison to their lowly leveraged rivals. Winsorized values of liquidity and growth capacity have statistically significant positive correlations, which underlines the significant role of cash-holdings among the assets held by an insurer. Interestingly, a positive correlation coefficient between the winsorized values of growth capacity (*WCAP*) and reserving errors (*WRESERR*) suggests that insurers with a higher capacity to grow tend to over-reserve. A negative correlation coefficient between *WLIQ* and *SIZE*, and a positive coefficient of correlation between *WLIQ* and *HINDX* shows that smaller and less diversified insurers tend to hold more cash on their balance sheets in comparison to their more diversified, larger competitors. A large, negative and statistically significant correlation coefficient between *SIZE* and *HINDX* shows that, unsurprisingly, larger firms tend to be more diversified than their smaller rivals. Larger insurers are also more likely to under-reserve and to have incomes outside the convex region of the tax schedule. On the other hand, less diversified insurers tend to have lower reserving errors as shown by the positive and statistically significant correlation

between the *HINDX* and *WRESERR*. Less diversified insurers are also more likely to have annual earnings in the convex section of the tax schedule as shown by a positive correlation between *HINDX* and *CTAX*. The three variables identified as instruments for predicting reinsurance ratio are not highly correlated with each other which adds weight to their validity as IVs. For example, *WRESERR* shares a statistically significant ($p \leq 0.01$ two-tailed) Pearson's correlation coefficient of magnitude 0.06 and 0.08 with *ROA* and *CTAX* respectively.

7.4 Multivariate Results

The baseline regressions to test the two main research hypotheses presented in Chapter 4 follow the method suggested in Newey and West (1987). This method has been chosen to account for the autocorrelation and heteroskedasticity present in the data as shown by the diagnostic tests. Apart from this, the estimates also control for arbitrary clustering within firms and over time across firms. The results obtained, along with the relevant diagnostic tests are being discussed in the following subsections 7.4.1 and 7.4.2.

7.4.1 Decision to Reinsure

The hypothesis regarding the decision to reinsure or not is tested by conducting a regression analysis based on the equation (6.7) put forward in section 6.6.1 of Chapter 6. Table 7.4 reports the relevant coefficient estimates and diagnostics. The coefficient estimate on the variable *REINSID*, which indicates the decision to reinsure, is negative and statistically significant ($p \leq 0.01$, one-tailed). This result provides evidence in favour of the first hypothesis that insurers utilising reinsurance for risk management generally have smaller risk premiums (cost of equity) in comparison to insurers who do not purchase reinsurance. As mentioned in section 4.3 of Chapter 4, reinsurance (risk management) can add value to a firm by enabling it to optimise its capital structure, and thus minimise its equity cost of capital. This finding is consistent with bivariate results which show that *REINSID* is negatively correlated to *RP*.

Table 7.4: Baseline Regression – Decision to Reinsure

Variable	Coeff.	Robust Std. Error	Two-tailed Test		One-tailed Test		95% Conf. Interval	
			Z	p-value	χ^2	p-value		
<i>REINSID</i>	-0.37	0.09	-3.95	0.00	15.63	0.00	-0.50	-0.32
<i>WLEV</i>	0.26	0.12	2.14	0.03	4.58	0.02	0.16	0.37
<i>WCAP</i>	-0.23	0.11	-2.05	0.04	4.22	0.02	-0.31	-0.13
<i>WLIQ</i>	0.01	0.01	2.10	0.04	4.43	0.02	0.01	0.02
<i>SIZE</i>	0.01	0.01	0.77	0.44	0.59	0.78	0.00	0.03
<i>HINDX</i>	0.27	0.10	2.58	0.01	6.65	0.00	0.21	0.35
<i>Constant</i>	5.78	0.21	27.83	0.00	-	-	5.62	5.98
<i>Time Effects</i>				No				
<i>Observations</i>				4916				
<i>Firms</i>				386				
Diagnostics								
(1)	Wooldridge test for first order autocorrelation in panel data F(1, 348) 155.97 p-value 0.00							
(2)	Modified Wald test for group-wise heteroskedasticity χ^2 (386) 7.70E+32 p-value 0.00							
(3)	F-Test that coefficients are jointly zero F(6, 385) 10.23 p-value 0.00							

(Source: Research Data). This table presents the results of the regression of *RP* on *REINSID* after controlling for other intervening variables. The regression follows the Newey and West (1987) method which controls for heteroskedasticity and autocorrelation. Standard errors are robust to clustering at the firm level and on time dimension. Diagnostic tests carried out to test the presence of serial autocorrelation, and heteroskedasticity in data; and collective validity of coefficients are also reported.

As expected, the winsorized value of leverage, *WLEV*, is positively and significantly associated with the cost of equity. Specifically, *WLEV* has an estimated coefficient of 0.26 with one-tailed p-value less than 0.05. This finding conforms to one of the postulates of the theory of capital structure put forward by Modigliani and Miller (1958, 1963) that the cost of equity is an increasing function of leverage. A high leverage leads to increased frictional costs, such as costs associated with financial distress, resulting in a higher equity risk premium. Not only this, but in the case of an insurance company, leverage is significant also from the perspective of product market performance, as policyholder customers are unwilling to pay high premiums for the policies issued by highly leveraged insurers (Doherty and Tinic, 1981; Wakker et al., 1997). Similarly, an insurer holding more capital than mandated by statutory regulations not only has a higher capacity to underwrite new policies, but is less likely to face a high probability of

ruin in the wake of low-frequency high-severity loss event. This argument suggests a negative relation between *WCAP* and the cost of equity. Indeed, as shown in Table 7.3, the regression coefficient corresponding to *WCAP* is negative and statistically significant ($p\text{-value} \leq 0.05$, one-tail).

For a non-financial firm, increased revenue leads to an increase in cash without a corresponding increase in its leverage. This, however, is not true for insurance companies. An increase in cash due to underwriting more risks is accompanied by a corresponding increase in leverage, which in turn can lead to a higher cost of equity. This mechanism explains the positive and statistically significant ($p\text{-value} \leq 0.01$, one-tail) coefficient corresponding to *WLIQ* in Table 7.4. At 0.012, this estimated coefficient is small, indicating that the liquidity level does not have a large impact on the cost of equity. Due to the greater reach of larger firms to capital markets, the cost of equity is generally expected to be negatively related to the firm size (e.g., see Fama and French, 1995). This observation however is not corroborated by results shown in Table 7.4, which reports that firm size does not have any statistically significant impact on the cost of equity. This result will be scrutinised further through the robustness tests reported in section 7.5 below.

Product diversification does have a statistically significant impact on the cost of equity. As expected, the cost of equity increases with an increase in *HINDEX*. Keeping in mind that *HINDEX* is an inverse proxy for product diversification; a positive coefficient indicates that the cost of equity increases as the degree of product diversification decreases. According to Table 7.4, *HINDEX* has a coefficient estimate of 0.27 significant at 1% level ($p\text{-value} \leq 0.01$, one-tail).

7.4.2 Extent of Reinsurance

The reinsurance volume decision model specified in equation (6.9) in section 6.6.1 of Chapter 6 is used to test the effect of the reinsurance ratio on the cost of equity. Regression estimates obtained are presented in Table 7.5. In preliminary tests, the Wooldridge Test (Wooldridge, 2002), and the Modified Wald Test (Greene, 2003) respectively confirm the presence of serial autocorrelation and heteroskedasticity in the sample used. Therefore, to control for confounding effects of arbitrary heteroskedasticity and autocorrelation, Newey and West's (1987) estimation

procedure with clustering across firm and year dimensions is implemented to derive consistent standard errors.

Table 7.5: Baseline Regression – Extent of Reinsurance

Variable	Coeff.	Robust Std. Err.	Two-tailed Test Z	p-value	One-tailed Test χ^2	p-value	95% Conf. Interval	
<i>WREINS</i>	-0.41	0.44	-0.92	0.36	0.85	0.18	-1.28 0.46	
<i>WREINS</i> ²	1.20	0.63	1.89	0.06	3.58	0.03	-0.04 2.44	
<i>WLEV</i>	0.08	0.14	0.55	0.58	0.30	0.29	-0.20 0.36	
<i>WCAP</i>	-0.30	0.11	-2.76	0.01	7.64	0.00	-0.52 -0.09	
<i>WLIQ</i>	0.02	0.01	2.68	0.01	7.20	0.00	0.00 0.03	
<i>SIZE</i>	0.01	0.01	0.59	0.56	0.35	0.72	-0.02 0.04	
<i>HINDX</i>	0.26	0.10	2.59	0.01	6.70	0.00	0.06 0.46	
Constant	5.49	0.22	24.83	0	-	-	5.06 5.92	
Inflection Point				0.17				
Time Effects				No				
Observations				4629				
Firms				367				
Diagnostics								
(1)	Wooldridge test for first order autocorrelation in panel data							
	F(1,332)	146.898		p-value	0.00			
(2)	Modified Wald test for group-wise heteroskedasticity							
	χ^2 (367)	1.9E+31		p-value	0.00			
(3)	F-Test that coefficients are jointly zero							
	F(7, 366)	4.86		p-value	0.00			

(Source: Research Data). This table presents the results of regression of *RP* on *REINS* and *REINS*² after controlling for other intervening variables. The regression follows Newey and West's (1987) method along with controlling for clustering at the firm level and on time dimension. Diagnostic tests carried out to test the presence of serial autocorrelation and heteroskedasticity in the data and the collective validity of coefficients are also reported.

In section 4.4.2 of Chapter 4, it was postulated that the equity risk premium is a quadratic function of the extent of reinsurance, which can be depicted graphically as a U-shaped (convex) curve. Given the condition that the cost of equity and reinsurance ratio cannot be negative; for the cost of equity to be a convex function of the reinsurance ratio, the estimated coefficients corresponding to *WREINS* and *WREINS*² must be negative and positive respectively. Table 7.5 confirms that this is indeed the case. Moreover, such a combination of coefficient estimates facilitates the calculation of the inflection point of the U-shaped curve.

The coefficient estimate corresponding to *WREINS*, however, is not significant at conventional levels ($p \leq 0.10$). *WREINS*², on the other hand, has a positive

coefficient which is statistically significant at the 5% level (one-tailed). Ambiguity arising from conflicting significance levels of coefficients corresponding to the reinsurance ratio suggests that either the effect of reinsurance on the cost of equity is weak, or the results could be affected by multicollinearity. To remedy this situation robustness tests are required, which will be discussed in the next sections of this chapter.

Among the control variables, leverage does not significantly impact on the cost of equity. The sign of the coefficient estimate remains unchanged from Table 7.4, which suggests that leverage is likely to be at least to some degree positively related to the cost of equity. *WCAP* on the other hand has a negative and statistically significant coefficient estimate (p-value ≤ 0.01 , one-tail). This finding reaffirms the results reported in Table 7.4 which suggest that the insurers with a relatively large capacity to underwrite new business have a smaller cost of equity.

The winsorized value of liquidity has a positive coefficient which is statistically significant at the 1% level. Similar to the regression results from the decision to reinsure model, the coefficient corresponding to *WLIQ* is small, confirming that liquidity only has a very small impact on the cost of equity. In line with the findings reported in Table 7.4, *HINDX* has a positive and statistically significant (p-value ≤ 0.01 , one-tail) coefficient as reported in Table 7.5. The magnitude of this estimated parameter is almost equal to the coefficient reported in Table 7.4. Size again is not a statistically significant determinant of the cost of equity, which is in line with the findings reported above in section 7.4.1.

Having discussed the baseline results, it is imperative that their robustness be tested using different procedures. The following sections report the results of various robustness tests conducted to verify the estimates.

7.5 Robustness Tests

To establish the consistency and reliability of empirical results reported in section 7.4 above, various robustness tests are conducted. More precisely, the estimation is carried out using five different techniques which allow for different data characteristics. The first technique employed combines an OLS estimation with the

non-parametric method of standard error estimation described in Driscoll and Kraay (1998) which controls for arbitrary spatial and temporal dependence in panel data. The second technique uses generalised least squares (GLS) methodology with standard errors corrected for first order serial autocorrelation. Greene (2003) argues that if data supports the assumption that firm fixed effects are uncorrelated with the regressors, then it is appropriate to treat firm specific intercepts as being randomly distributed across firms with certain finite variance. Under these conditions, GLS produces unbiased, consistent and efficient estimates of model parameters. Gelman and Hill (2007) explain that the fixed effects estimator can be considered to be a special case of GLS estimator which assumes the variance of firm fixed effects to be infinite. However, if firm specific effects are correlated with other explanatory variables, then the GLS estimator is consistent but biased, whereas the fixed effects estimator is unbiased (Greene, 2003). The explanatory variables in this study are correlated with firm fixed effects; therefore GLS estimates could be biased. On the other hand, Clark and Linzer (2012) point out that the fixed effects estimator requires centring the data on the firm specific mean, and therefore it is sample specific. It follows that the estimates produced by the fixed effects estimator are then not applicable out of the sample. Using Monte Carlo simulations, Clark and Linzer (2012) show that for a dataset with a small number of observations per firm (≤ 20), and moderate correlation (correlation coefficient ranging from 0.3 to 0.5) between firm fixed effects and other explanatory variables, GLS, is more consistent than the fixed effects estimator. Nevertheless, for comparative purposes, both hypotheses are tested here using estimates based on both the GLS and fixed effects estimation techniques. Two versions of each estimator are used, first controlling only for autocorrelation; and the second, controlling both for heteroskedasticity and autocorrelation.

For brevity, all the techniques mentioned above are abbreviated. OLS_DK is used to denote the estimates obtained using OLS with standard errors computed using the method of Driscoll and Kraay (1998). GLS_AC denotes the GLS estimator estimated assuming the presence of first-order autocorrelation in the estimation sample. GLS_HAC denotes the GLS estimator controlling for first order autocorrelation within firms and presence of heteroskedasticity across firms. FE_AC denotes the fixed effects estimator with standard errors corrected for first-

order autocorrelation in the error term. FE_HAC denotes fixed effects estimator with standard errors corrected for first-order autocorrelation in the error term and presence of heteroskedasticity across firms. All the estimators take account of time specific effects by including year dummies in the model. GLS_AC, GLS_HAC and FE_HAC discard 19 observations corresponding to firms that had only one observation during the period of study.

7.5.1 Robustness Test for Decision to Reinsure Hypothesis

Parameter estimates obtained on the testing decision to reinsure hypothesis using the techniques mentioned above are reported in Table 7.6. Table 7.6 shows that the coefficient estimate corresponding to the *REINSID* is negative across all the methods and statistically significant at the 1% level (two tail) for OLS_DK, GLS_AC and GLS_HAC estimators. The magnitude of the estimate though is not consistent across estimators. However, this is not a cause for concern in testing the reinsurance decision model as the primary objective is to test the direction of the relation rather than the magnitude of the effect. These results demonstrate that users of reinsurance have a lower cost of equity in comparison to non-users of reinsurance. The estimated coefficient for *WLEV* is inconsistent across estimators as two estimators confirm a statistically significant positive relation with the cost of equity, whereas one technique shows a negative relation. Since the GLS estimator is consistent even though biased, it is more likely to provide an estimate closer to the 'true estimate' (Clark and Linzer, 2012). Therefore, it is reasonable to assume that the leverage has a positive relation with the cost of equity as confirmed by prior studies such as Botosan and Plumlee (2005)³⁶.

The coefficient estimate for *WCAP* is consistently negative across all the estimators and is statistically significant at the 1% level (two tail) according to the four estimators. This finding confirms that the cost of equity is indeed lower for firms that have a larger capacity to underwrite new business. Similarly, the relation between

³⁶ Botosan and Plumlee (2005) use long-term liabilities at the end of the fiscal year scaled by the market value of equity as the measure of leverage. Their cost of equity estimates are derived from market-based accounting methods discussed in chapter 5 of this thesis.

Table 7.6: Robustness Tests – Decision to Reinsure

Variable	OLS_DK	GLS_AC	GLS_HAC	FE_AC	FE_HAC
<i>REINSID</i>	-0.376*** (0.048)	-0.111*** (0.020)	-0.024*** (0.008)	-0.027 (0.021)	-0.027 (0.031)
<i>WLEV</i>	0.271*** (0.059)	0.023 (0.028)	0.029** (0.012)	-0.060 (0.045)	-0.060* (0.036)
<i>WCAP</i>	-0.223*** (0.067)	-0.057*** (0.019)	-0.005 (0.008)	-0.085*** (0.027)	-0.085*** (0.026)
<i>WLIQ</i>	0.013*** (0.003)	0.004*** (0.001)	0.001** (0.000)	0.006** (0.002)	0.006*** (0.002)
<i>SIZE</i>	0.016*** (0.003)	-0.009* (0.006)	-0.021*** (0.002)	0.005 (0.007)	0.005 (0.008)
<i>HINDX</i>	0.290*** (0.031)	0.160*** (0.025)	0.129*** (0.012)	0.070* (0.035)	0.070* (0.040)
<i>Constant</i>	5.734*** (0.069)	5.771*** (0.067)	5.804*** (0.027)	5.643*** (0.081)	- -
<i>Time Effects</i>	Yes	Yes	Yes	Yes	Yes
<i>Observations</i>	4916	4897	4897	4916	4897
<i>Firms</i>	386	367	367	386	367
<i>Obs. per Firm</i>					
<i>Minimum</i>	1	2	2	1	2
<i>Average</i>	12.70	13.34	13.34	12.70	13.34
<i>Maximum</i>	26	26	26	26	26

(Source: Research Data). OLS_DK denotes the estimates obtained using OLS with standard errors computed using the method of Driscoll and Kraay (1998). GLS_AC denotes the GLS estimator estimated assuming a first order autocorrelation in the error term. GLS_HAC denotes the GLS estimator estimated assuming a first order autocorrelation in the error term and the presence of heteroskedasticity across firms. FE_AC denotes the fixed effects estimator with standard errors corrected for first order autocorrelation in the error term. FE_HAC denotes a fixed effects estimator with standard errors corrected for first order autocorrelation in the error term and the presence of heteroskedasticity across firms. Superscripts *, ** and *** denote the statistical significance at the 10%, 5% and 1% level respectively (two-tail). Robust standard errors are reported in parentheses under the respective parameter estimates.

WLIQ and equity risk premium is consistent and statistically significant (p-value ≤ 0.05 , two tail) across all the estimators. The magnitude of the coefficient though is small suggesting that the liquidity levels do not have a large impact on the cost of equity. As with leverage, the sign (direction) of the coefficient estimate corresponding to firm size too is not consistent across all the estimators. Among the three estimators for which this coefficient is statistically significant (p-value ≤ 0.10 , two tail), two GLS estimators suggest an inverse relation and OLS_DK a positive relation between the cost of equity and size. The coefficient estimates obtained using GLS are more efficient in the presence of heteroskedasticity and

autocorrelation, (Wooldridge, 2002). Therefore, it is appropriate here to accept the results of the GLS estimators, which are in accordance with the findings of prior research based on the data drawn from the US corporate sector (e.g. see Botosan *et al.* 2011; Fama and French, 1995).

The coefficient estimates for *HINDX* are in line with expectations and are statistically significant across all the estimators at the 10% level or better (two tail). These results make it clear that firms with a higher product diversification tend to have a lower cost of equity compared with their less diversified counterparts. Similarly, the results from all the estimators confirm that firm-specific effects play a significant role in determining cost of equity as the constant term of comparable magnitude is observed across all four estimators.

7.5.2 Robustness Test for Reinsurance Volume Decision Hypothesis

Table 7.7 presents parameter estimates for the reinsurance volume decision hypothesis obtained by using the five regression techniques described above. Coefficient estimates for the linear term of reinsurance ratio is negative for all and statistically significant (p-value ≤ 0.05 , two tail) for four estimators. Moreover, the quadratic term of the reinsurance ratio is positive and statistically significant over all the estimators at the 5% level (two-tailed) or better. As explained in section 7.4.2, this is desirable given that the cost of equity and the reinsurance ratio are always positive. Such a combination of coefficient estimates for *WREINS* and *WREINS*² facilitates the calculation of the point of inflection of the U-shaped curve predicted by this hypothesis, which is reported in Table 7.7 for each set of coefficients. These results indicate that the cost of equity, as predicted, is indeed a quadratic function of the reinsurance ratio. The inflection points calculated using these estimates correspond to reinsurance ratio values ranging from a minimum of 0.172 to a maximum of 0.329. Given that the median value of the reinsurance ratio in the estimation sample is 0.26 (see Table 7.1), the inflection point of 0.245 corresponding to GLS_HAC seems the most appropriate, as most of the UK non-life insurers will try to achieve this ratio in order to optimise their capital structure.

Table 7.7: Robustness Tests – Extent of Reinsurance

Variable	OLS_DK	GLS_AC	GLS_HAC	FE_AC	FE_HAC
<i>WREINS</i>	-0.422 (0.249)	-0.360*** (0.089)	-0.101*** (0.039)	-0.235*** (0.056)	-0.235** (0.113)
<i>WREINS</i> ²	1.221*** (0.345)	0.555*** (0.139)	0.206*** (0.064)	0.357*** (0.102)	0.357** (0.181)
<i>WLEV</i>	0.090 (0.063)	0.029 (0.028)	0.028** (0.013)	-0.055 (0.051)	-0.055 (0.040)
<i>WCAP</i>	-0.298*** (0.060)	-0.054*** (0.020)	-0.006 (0.009)	-0.080*** (0.028)	-0.080*** (0.026)
<i>WLIQ</i>	0.017*** (0.002)	0.003** (0.001)	0.001** (0.000)	0.005** (0.003)	0.005** (0.002)
<i>SIZE</i>	0.015*** (0.004)	-0.013** (0.006)	-0.021*** (0.002)	0.006 (0.007)	0.006 (0.008)
<i>HINDX</i>	0.286*** (0.035)	0.121*** (0.025)	0.119*** (0.013)	0.062 (0.042)	0.062 (0.043)
<i>Constant</i>	5.417*** (0.095)	5.751*** (0.067)	5.777*** (0.023)	5.607*** (0.086)	- -
<i>Inflection Point</i>	0.173	0.324	0.245	0.329	0.329
<i>Time Effects</i>	Yes	Yes	Yes	Yes	Yes
<i>Observations</i>	4629	4610	4610	4629	4610
<i>Firms</i>	367	348	348	367	348
<i>Obs. per Firm</i>					
<i>Minimum</i>	1	2	2	1	2
<i>Average</i>	12.60	13.25	13.25	12.60	13.25
<i>Maximum</i>	26	26	26	26	26

(Source: Research Data). OLS_DK denotes the estimates obtained using OLS with standard errors computed using the method of Driscoll and Kraay (1998). GLS_AC denotes the GLS estimator estimated assuming a first order autocorrelation in the error term. GLS_HAC denotes the GLS estimator estimated assuming a first order autocorrelation in the error term and the presence of heteroskedasticity across firms. FE_AC denotes the fixed effects estimator with standard errors corrected for first order autocorrelation in the error term. FE_HAC denotes the fixed effects estimator with standard errors corrected for first order autocorrelation in the error term and the presence of heteroskedasticity across firms. Superscripts *, ** and *** denote a statistical significance at the 10%, 5% and 1% level respectively (two-tail). Robust standard errors are reported in parentheses under the respective parameter estimates.

Estimated coefficients corresponding to leverage are inconsistent across the estimators and statistically significant only for GLS_HAC at the 5% level (two-tailed). Due to the reasons discussed in section 7.5.1, the estimates produced by GLS after controlling for heteroskedasticity and autocorrelation (GLS_HAC) are considered appropriate. Therefore, it follows from this result that the cost of equity is an increasing function of leverage. On the other hand, the estimated coefficient for *WCAP* is negative for all the estimators and significant for four, therefore it can

be concluded that the cost of equity increases as the growth capacity of an insurer reduces. Similarly, statistically significant coefficient estimates with a consistent sign are obtained for liquidity. This observation suggests that liquidity levels have a small but significant effect on the equity risk premium demanded by the investors. Further, coefficient estimates corresponding to firm size are again inconsistent as reported earlier in section 7.5.1. Therefore, based on the reasons mentioned above, the coefficient estimate obtained using GLS_HAC is considered to be the most reasonable estimate. This result shows that smaller insurers have a larger cost of equity in comparison with their larger competitors. The coefficient estimate for *HINDX* is positive for all the regressions and is statistically significant for three estimators, which is similar to the results reported in section 7.5.1 above. Therefore, it is concluded that non-life insurers with more diversified product offerings tend to have a lower cost of equity than non-life insurers with a more concentrated product-mix.

7.6 Sensitivity Tests

This section of the thesis examines the consistency of the decision to reinsure and the extent of the reinsurance models to sensitivity tests based on different criteria. First, the sensitivity of the respective models to an alternative measure of cost of equity, calculated using the CAPM, is established. This is followed by a test for the sensitivity of the aforementioned models to multicollinearity. As explained in section 7.5, after controlling for heteroskedasticity and serial autocorrelation, GLS based estimates are found to be the most appropriate in the context of this study. Therefore, the GLS_HAC regression is used to test the sensitivity of both models.

7.6.1 Sensitivity to Alternative Cost of Equity Measure

Table 7.8 reports the results obtained from the regression of CAPM based equity risk premium estimates (*RP_CM* in Table 7.1) on *REINSID* and other control variables. All the findings are consistent with those reported in Table 7.6 under the column labelled GLS_HAC. Although the magnitude of the coefficient estimate changes, the corresponding signs remain as reported in Table 7.6. All the coefficient estimates are in line with expectations, and they are statistically

significant (p -value ≤ 0.10 , one-tailed). This result proves that, all else being equal, users of reinsurance have a lower cost of equity as compared with insurers not using reinsurance. Similarly, larger insurers enjoy a lower cost of equity in comparison with their smaller rivals. On the other hand, insurers with higher leverage, lower diversification, and higher liquidity correspondingly have to contend with a higher equity risk premium and cost of equity.

Table 7.8: Sensitivity Test - Decision to Reinsure

Variable	Coeff.	Robust Std. Err.	Two-tailed Test		One-tailed Test		95% Conf. Interval	
			Z	p-value	χ^2	p-value		
<i>REINSID</i>	-0.03	0.00	-5.86	0.00	34.29	0.00	-0.04	-0.02
<i>WLEV</i>	0.01	0.01	1.70	0.09	2.88	0.04	0.00	0.02
<i>WCAP</i>	-0.01	0.00	-1.33	0.19	1.76	0.09	-0.01	0.00
<i>WLIQ</i>	0.00	0.00	1.78	0.08	3.17	0.04	0.00	0.00
<i>SIZE</i>	-0.02	0.00	-13.07	0.00	170.77	0.00	-0.02	-0.01
<i>HINDX</i>	0.05	0.01	8.30	0.00	68.85	0.00	0.04	0.06
<i>Constant</i>	5.63	0.01	390.89	0.00	-	-	5.60	5.66
<i>Time Effects</i>				Yes				
<i>Observations</i>				4897				
<i>Firms</i>				367				
<i>Obs. Per Firm</i>	Min	2		Mean	13.34		Max	26
Diagnostics								
(1)	First Order Autocorrelation Coefficient							
	AR(1)	0.87						
(2)	Wald Test that coefficients are jointly zero							
	$\chi^2(31)$	669.49		p-value	0.00			

(Source: Research Data). This table presents the results of the regression of *RP_CM* on *REINSID* after controlling for other intervening variables. The regression is conducted using the GLS method taking into account firm level heteroskedasticity and serial autocorrelation. Year dummies are included in the regression to control for time-specific effects. Diagnostic tests carried out to test the presence of the first order autocorrelation and collective validity of coefficients are also reported.

Next, the sensitivity of the extent of the reinsurance hypothesis to *RP_CM* is tested. This test shows that the reinsurance volume decision is sensitive to the measure of the cost of equity used. A possible reason for this may be that the CAPM, being a parametric method of estimating the cost of equity, fails to capture the higher moments of the cost of equity distribution, which are priced by the market (He and Leland, 1993). This could lead the cost of equity – reinsurance ratio relation to potentially become more susceptible to the relatively high values of the reinsurance ratio. To test the sensitivity of *RP_CM* to large values of the

Table 7.9: Sensitivity Test – Extent of Reinsurance

Variable	Percentile of Reinsurance Ratio			
	25	50	75	100
<i>WREINS</i>	-3.173*** (0.314)	-0.239*** (0.073)	-0.016 (0.025)	0.013 (0.013)
<i>WREINS</i> ²	24.050*** (2.850)	0.775*** (0.252)	0.016 (0.046)	-0.035*** (0.013)
<i>WLEV</i>	0.044** (0.018)	0.025* (0.013)	0.016** (0.008)	0.018*** (0.006)
<i>WCAP</i>	-0.002 (0.012)	-0.024*** (0.008)	-0.005 (0.005)	0.000 (0.004)
<i>WLIQ</i>	0.003*** (0.001)	0.003*** (0.001)	0.001*** (0.000)	0.000 (0.000)
<i>SIZE</i>	-0.021*** (0.002)	-0.016*** (0.002)	-0.017*** (0.001)	-0.016*** (0.001)
<i>HINDX</i>	-0.011 (0.016)	0.026** (0.011)	0.045*** (0.007)	0.025*** (0.006)
<i>Constant</i>	5.711*** (0.031)	5.600*** (0.023)	5.609*** (0.016)	5.602*** (0.015)
<i>Inflection Point</i>	0.066	0.154	0.500	0.186
<i>AR(1) Coefficient</i>	0.792	0.800	0.871	0.880
<i>Time Effects</i>	Yes	Yes	Yes	Yes
<i>Observations</i>	1120	2278	3448	4610
<i>Firms</i>	144	239	310	348
<i>Observations per Firm</i>				
<i>Minimum</i>	2	2	2	2
<i>Average</i>	7.78	9.53	11.12	13.25
<i>Maximum</i>	23	26	26	26

(Source: Research Data). This table presents the results of the regression of *RP_CM* on *REINS* and *REINS*² after controlling for other intervening variables. The regression is conducted at the 25th, 50th, 75th and 100th percentiles of the reinsurance ratio using the GLS method taking into account firm level heteroskedasticity and serial autocorrelation. Year dummies are included in the regression to control for time-specific effects. Diagnostic test carried out to test the presence of first order autocorrelation and inflection point indicated by coefficients are also reported. Superscripts *, ** and *** denote the statistical significance at the 10%, 5% and 1% level respectively (two-tail). Robust standard errors are reported in parentheses under the respective parameter estimates.

reinsurance ratio, the estimation was done at different levels of the reinsurance ratio. More specifically, the estimation sample size was progressively increased corresponding to the 25th, 50th, 75th and 100th percentiles of reinsurance ratio. These estimates are presented in Table 7.9.

Table 7.9 shows that the *RP_CM* and reinsurance ratio is not stable across the entire estimation sample. At sample sizes corresponding to the 25th and 50th

percentiles of the reinsurance ratio, the estimates concur with the results reported in the column labelled GLS_HAC of Table 7.7. However, the results corresponding to the 75th and 100th percentiles of the reinsurance ratio are different from the GLS_HAC results reported in Table 7.7. In fact, the estimates corresponding to the full sample, though not statistically significant, indicate an inverted U-shaped (concave) relation between *RP_CM* and the reinsurance ratio. These results make it clear that the relation between the cost of equity and the reinsurance ratio is indeed susceptible to the larger values of the reinsurance ratio if the cost of the equity estimate based on CAPM is used in the regression analysis.

7.6.2 Sensitivity to Multicollinearity

As mentioned previously in section 7.4.2, multicollinearity is a potential cause for concern in this research. Hence, to establish the validity of coefficient estimates in the presence of multicollinearity, five more regressions are run for each of the hypotheses. One of the five control variables is absent in each of the five regressions. If a reversal in direction (change of sign) or a change in the statistical significance of the coefficient estimates is observed in these regressions, then it can be seen as evidence for the susceptibility of the results to multicollinearity. Panel A of Table 7.10 reports the results for the reinsurance participation model (H1), whereas the results related to the reinsurance volume decision model (H2) are reported in Panel B. The results obtained confirm that coefficient estimates are not severely distorted by multicollinearity. Table 7.10 also confirms that the direction and statistical significance of all the relations is robust to multicollinearity.

Table 7.10: Sensitivity of the Estimates to Multicollinearity

Panel A: Decision to Reinsure

Variable	H1_M1	H1_M2	H1_M3	H1_M4	H1_M5
<i>REINSID</i>	-0.023*** (0.008)	-0.023*** (0.008)	-0.029*** (0.008)	-0.037*** (0.008)	-0.034*** (0.009)
<i>WLEV</i>		0.029** (0.012)	0.022** (0.011)	0.025** (0.012)	0.033*** (0.012)
<i>WCAP</i>	-0.006 (0.008)		-0.001 (0.008)	-0.01 (0.008)	-0.003 (0.008)
<i>WLIQ</i>	0.001*** (0.000)	0.001** (0.000)		0.002*** (0.000)	0.001*** (0.000)
<i>SIZE</i>	-0.021*** (0.002)	-0.021*** (0.002)	-0.020*** (0.002)		-0.025*** (0.002)
<i>HINDX</i>	0.129*** (0.012)	0.128*** (0.012)	0.132*** (0.012)	0.157*** (0.011)	
<i>Constant</i>	5.807*** (0.027)	5.804*** (0.026)	5.796*** (0.026)	5.587*** (0.015)	5.940*** (0.021)

Panel B: Extent of Reinsurance

Variable	H2_M1	H2_M2	H2_M3	H2_M4	H2_M5
<i>WREINS</i>	-0.095** (0.039)	-0.107*** (0.037)	-0.100*** (0.039)	-0.115*** (0.039)	-0.118*** (0.040)
<i>WREINS</i> ²	0.210*** (0.064)	0.209*** (0.060)	0.207*** (0.063)	0.240*** (0.063)	0.227*** (0.066)
<i>WLEV</i>		0.030** (0.012)	0.031** (0.013)	0.028** (0.013)	0.032** (0.013)
<i>WCAP</i>	-0.006 (0.009)		-0.005 (0.009)	-0.013 (0.009)	-0.005 (0.009)
<i>WLIQ</i>	0.001** (0.000)	0.001** (0.000)		0.002*** (0.000)	0.001** (0.000)
<i>SIZE</i>	-0.021*** (0.002)	-0.021*** (0.002)	-0.022*** (0.002)		-0.029*** (0.002)
<i>HINDX</i>	0.120*** (0.013)	0.116*** (0.013)	0.120*** (0.013)	0.138*** (0.013)	
<i>Constant</i>	5.783*** (0.023)	5.782*** (0.024)	5.787*** (0.025)	5.558*** (0.015)	5.938*** (0.019)
<i>Inflection Point</i>	0.226	0.256	0.242	0.240	0.260

(Source: Research Data). This table presents the results of regressions testing sensitivity of estimates to multicollinearity. Panel A reports the regression results for the decision to reinsure model, whereas Panel B is for the reinsurance volume decision. All regressions use the GLS method taking into account firm level heteroskedasticity, serial autocorrelation and time-specific effects. One variable out of five control variables is absent from each of five regression estimates. Superscripts *, ** and *** denote statistical significance at the 10%, 5% and 1% level respectively (two-tail). Robust standard errors are reported in parentheses under the respective parameter estimates.

7.7 Endogeneity and IV estimation

As mentioned in section 6.6.2 of this thesis, the cost of equity and reinsurance, being elements of the capital structure of an insurer raises concerns about potential endogeneity. Based on suggestions made in the econometric literature, such as Wooldridge (2002) and Greene (2003), the IV estimation was identified in section 6.7 to mitigate the issue of variable endogeneity. The results of 2SLS regressions based on the IV approach are presented in this section. Both the stages use the GLS estimation for controlling both heteroskedasticity and serial autocorrelation in the panel dataset. Table 7.11 presents the results of the first-stage regressions, which are used to predict the values of the reinsurance ratio. All the instruments used to predict reinsurance are found to be significant at the 5% level (one-tailed as well as two-tailed). The Chi-square test of endogeneity rejects the null of no endogeneity at the 5% level of significance. Thus, IV estimation is indeed required. Moreover, the centred R-squared value of 0.33 indicates a good fit between the predictors and the reinsurance ratio. The F-test too provides strong support for the joint validity of the coefficient estimates. The values of the reinsurance ratio predicted following the first stage regression, named *PREINS*, range from a minimum of 0.006 to a maximum of 0.75. The respective mean and median values of *PREINS* at 0.27 and 0.25 are close to the mean and median values of the reinsurance ratio reported in Table 7.1. The variation in *PREINS* with a standard deviation of 0.14 is approximately half of that observed for *REINS*. However, similar to *REINS*, within-firm variation in *PREINS* is lower than the between-firm variation.

In the second-stage of the IV estimation, the equity risk premium is regressed on the predicted values of the reinsurance ratio along with other control variables. To establish the sensitivity of the risk premium – reinsurance ratio relation, the regression is conducted at different sample sizes based on the 25th, 50th and 75th and 100th percentiles of *PREINS*. The results obtained employ the GLS method and control for heteroskedasticity and serial autocorrelation. These are reported in Table 7.12. These results confirm that the cost of equity–reinsurance ratio relation

Table 7.11: IV Estimation – First-Stage Results

Variable	Coeff.	Robust Std.Err.	Two-tailed Test		One-tailed Test		95% Conf. Interval	
			Z	p-value	χ^2	p-value		
<i>WRESERR</i>	-0.037	0.02	-2.00	0.05	3.99	0.02	-0.07	0.00
<i>ROA</i>	-0.292	0.05	-5.66	0.00	32.00	0.00	-0.39	-0.19
<i>CTAX</i>	0.023	0.01	2.03	0.04	4.12	0.02	0.00	0.05
<i>WLEV</i>	0.684	0.03	22.13	0.00	489.88	0.00	0.62	0.74
<i>WCAP</i>	0.156	0.02	6.47	0.00	41.92	0.00	0.11	0.20
<i>WLIQ</i>	0.009	0.00	5.35	0.00	28.60	0.00	0.01	0.01
<i>SIZE</i>	-0.023	0.00	-8.75	0.00	76.59	0.00	-0.03	-0.02
<i>HINDX</i>	-0.238	0.02	-14.14	0.00	200.08	0.00	-0.27	-0.20
<i>Constant</i>	0.391	0.04	9.6	0.00	-	-	0.31	0.47
<i>Time Effects</i>				Yes				
<i>Observations</i>				3054				
<i>Firms</i>				250				
Diagnostics								
(1)	Chi-square test for presence of endogeneity under null of no endogeneity							
	$\chi^2(1)$	4.25		p-value	0.04			
(2)	Wald Test that coefficients are jointly zero							
	F(32, 3021)	36.95		p-value	0.00			
(3)	R-squared statistic for goodness of fit							
	Centred	0.33		Uncentred	0.70			

(Source: Research Data). This table presents the first stage results of two stage IV estimations to control for endogeneity. The regression uses the Newey and West (1987) method taking into account firm level heteroskedasticity and serial autocorrelation. Diagnostic tests carried out to test the presence of endogeneity, joint validity of coefficients and goodness of fit are also reported.

is of quadratic form albeit susceptible to extreme values of reinsurance ratio. As expected, the coefficient estimate for *PREINS* and its squared term are respectively negative and positive at all percentiles of *PREINS*. Moreover, the coefficient estimates follow the patterns reported in sections 7.4, 7.5 and 7.6 above. For example, leverage is positively and significantly related to the equity risk premium across all the samples. Similarly, liquidity is positively related to risk premium in all the regressions. The coefficient estimates for firm size corresponding to the 50th and higher percentiles are consistent in magnitude, negative and statistically significant at the 1% level. The points of inflection corresponding to the estimated coefficients related to the 25th, 50th and 75th percentiles too are in the vicinity of those reported in sections 7.4, 7.5 and 7.6. First-order serial correlation coefficients are also of comparable magnitudes across the samples.

Table 7.12: IV Estimation – Second-Stage Results

Variable	Percentile of Reinsurance Ratio			
	25	50	75	100
<i>PREINS</i>	-0.556 (0.355)	-0.482** (0.191)	-0.380*** (0.127)	-0.070 (0.073)
<i>PREINS</i> ²	0.945 (1.737)	0.912 (0.586)	0.694** (0.280)	0.032 (0.087)
<i>WLEV</i>	0.337*** (0.104)	0.201*** (0.069)	0.110* (0.056)	0.096** (0.041)
<i>WCAP</i>	-0.044 (0.029)	-0.019 (0.018)	-0.017 (0.016)	-0.008 (0.011)
<i>WLIQ</i>	0.011*** (0.004)	0.004** (0.002)	0.005*** (0.001)	0.001 (0.001)
<i>SIZE</i>	0.004 (0.007)	-0.029*** (0.005)	-0.025*** (0.004)	-0.029*** (0.004)
<i>HINDX</i>	0.297*** (0.053)	0.096*** (0.035)	-0.016 (0.028)	0.006 (0.021)
<i>Constant</i>	5.237*** (0.118)	5.720*** (0.076)	5.777*** (0.062)	5.801*** (0.051)
<i>Inflection Point</i>	0.294	0.264	0.274	1.094
<i>AR(1) Coefficient</i>	0.81	0.86	0.88	0.90
<i>Time Effects</i>	Yes	Yes	Yes	Yes
<i>Observations</i>	730	1490	2265	3039
<i>Firms</i>	112	170	221	250
<i>Observations per Firm</i>				
<i>Minimum</i>	2	2	2	2
<i>Average</i>	6.52	8.76	10.25	12.16
<i>Maximum</i>	25	25	25	25

(Source: Research Data). This table presents the second stage results of the two stage IV estimation to control for endogeneity. The regression is conducted using sample sizes based on maximum values of the predicted values of the reinsurance ratio restricted to the 25th, 50th, 75th and 100th percentiles *PREINS*. The regressions use the GLS method taking into account firm level heteroskedasticity, serial autocorrelation and time specific effects. The diagnostic test carried out to test the presence of a serial autocorrelation is also reported. Superscripts *, ** and *** denote statistical significance at the 10%, 5% and 1% levels respectively (two-tail). Robust standard errors are reported in parentheses under the respective parameter estimates.

7.8 Conclusions

This chapter tests the cost of equity – reinsurance relation using two hypotheses and five control variables formulated in Chapter 4 using a panel dataset from 386 firms operating in the UK’s non-life insurance market from 1985-2010. The empirical results obtained from the statistical procedures described in sections 6.6

and 6.7 of Chapter 6 are reported and discussed in this chapter. Both the hypotheses forwarded in Chapter 4 are supported by the empirical results presented in this chapter. The equity risk premium is found to be lower for users of reinsurance compared with non-users. It is also found that the cost of equity increases with an increase in leverage, and liquidity-risk. On the other hand, the risk premium is lower for firms that are larger, have a greater capacity to underwrite new business, and are more diversified in product-markets. These findings provide support for the idea that reinsurance (risk management) is a value-added activity in terms of risk reduction (lower equity risk premium).

The regression analysis conducted to test the reinsurance volume decision model reveals that the equity risk premium and reinsurance ratio have a quadratic relation which graphically is U-shaped (convex). Apart from this, the results corresponding to control variables show respective relations to be in predicted directions, proving that the control variables included in the study influence the cost of equity. These findings add support to the trade-off, pecking order and agency cost based arguments behind the theory of optimal capital structure. Moreover, these results prove that reinsurance is a key component of the capital structure of an insurance company, and that risk management and capital structure decisions are intertwined. The main conclusions of this study and implications for prospective research are evaluated in next and final chapter of this thesis.

CHAPTER 8. CONCLUSIONS

8.1 Introduction

A summary of the thesis and its key findings are presented in this final chapter of the thesis. Section 8.1 begins by providing an overview of the research objectives and follows it by restating the methodological and theoretical underpinnings of this study. Section 8.2 summarises the key empirical results obtained using the statistical analysis. Section 8.3 considers the main conclusions and implications of the study. The limitations of the study and prospective areas for future research are discussed in section 8.4.

8.2 Project Overview

The value-added realised by corporate hedging has been an issue of debate in the academic finance literature. Explanations based on an assumption of efficient financial markets conclude that corporate hedging is a non-value-added activity, as shareholders can diversify away the firm-specific risks on their own accord by holding balanced portfolios of investment. On the other hand, inefficient financial markets engender frictional costs (such as financial distress and bankruptcy costs) which can be mitigated by risk management. This makes financial hedging a value-added activity. There are two channels through which financial hedging could increase the traded value of a firm. First, risk management can stabilise and/or increase future cash flows by minimising frictional costs, resulting in a higher traded value. Second, it can reduce the perceived riskiness of a firm, resulting in a lower cost of capital. The first channel has been investigated in many studies (e.g., see Mayers and Smith, 1990; Nance et al., 1993; Plantin, 2006; Zou, 2010), whereas the second channel has hitherto remained insufficiently explored in the academic literature. Research on the relation between the cost of equity and corporate risk management is even scarcer in the case of financial intermediaries such as insurers. One key constraint in pursuing such research is a lack of

sufficient data to conduct meaningful analyses. However, this limitation is overcome in the case of the UK's insurance industry because of the legal obligation imposed on insurers to report the purchase of reinsurance in their annual statutory reports. Motivated by the dearth of empirical evidence on the effect of corporate financial hedging on the cost of equity, especially in the case of financial intermediaries, this study thus attempts to investigate the aforementioned relation in the UK non-life insurance market. Specifically, two main research questions are addressed:

- *Does reinsurance influence an insurer's cost of equity capital?*
- *If it does, then to what extent does reinsurance impact on an insurer's cost of equity capital?*

The UK's non-life insurance market is a well-developed large international insurance market with a long history and homogenous regulations. Non-life insurance industry regulations in the UK are targeted at maintaining the confidence of the investors and protecting the rights of the customers. However, this does not result in regulatory requirements intervening with the industry's capability to innovate and introduce new products onto the market. Such a unitary regulatory/fiscal regime reduces the possibility of biases being induced by variations in State-based regulatory practices relating to premium rate regulation and taxation. Moreover, the greater prevalence of reinsurance in the non-life compared with the life sector of the insurance market, and independence of managerial decisions to purchase reinsurance from statutory requirements further facilitate prospectively 'cleaner' tests of the proposed research questions in the context of the UK non-life insurance market. Furthermore, the availability of a reasonably long time-series of data (1985-2010) makes statistical analysis robust to time-specific macroeconomic events. Chapter 2 of this thesis provides details of the key institutional features of the UK's property-liability insurance market.

A critique of positive-descriptive theories in the financial economics literature that are relevant in addressing the two aforementioned research questions is presented in Chapter 3 of this thesis. This review led to the identification of the theory of optimal capital structure as the most appropriate and viable framework within which to guide the empirical analysis to be carried out (see Chapter 3,

section 3.3.). Two key hypotheses regarding the linkage between the cost of equity and reinsurance were then put forward in Chapter 4 (section 4.4) based on a framework drawn from the theory of optimal capital structure. Subsequently, after a careful review of various cost of equity metrics in Chapter 5, the R-L model (Leland, 1999; Rubinstein, 1976) and the CAPM (Lintner, 1965; Sharpe, 1964) were selected as the appropriate cost of equity models to be employed in the context of this study. The selection of these models is also influenced by the data constraints as described in Chapter 6 (section 6.4).

Justification for the use of the statistical analysis, which is scientifically rigorous and produces generalizable results, is provided in Chapter 6 (section 6.2). The data used for empirical analysis were obtained from Standards & Poor's "SynThesys Non-Life Insurance" database, which provides the returns submitted to the UK regulatory authorities by UK-licensed insurance companies. The sampling procedure detailed in Chapter 6 (section 6.3) resulted in a panel dataset comprising 386 UK-based non-life insurers over the twenty-six years 1985-2010. The method of regression analysis described in Newey and West (1987) is employed in this study to test empirically the two main hypotheses put forward in this research project. This method controls for arbitrary heteroskedasticity and serial autocorrelation, which might be present in the data. Moreover, to account for time-specific events, year-dummies are also included in the regression analysis. The empirical results obtained are reported in Chapter 7 of this thesis. Furthermore, a battery of sensitivity and robustness tests was employed to ascertain the robustness of statistical results to endogeneity and multicollinearity. Overall, the two research hypotheses are supported by the empirical evidence presented in this study. The main conclusions and implications arising from the data analysis reported in Chapter 7 are now presented in the following section 8.3.

8.3 Main Conclusions and Implications

The linkage between risk management and the capital structure of a firm has been examined in several academic studies (e.g., see Froot et al., 1993; Froot and Stein, 1998; Leland, 1998; Stulz, 1996). These studies argue that risk management enables companies to optimise their capital structure by stabilising

future cash flows and/or minimising frictional costs. The current study examines the role played by reinsurance in determining the cost of equity finance in the UK non-life insurance sector. Following is a discussion of the main conclusions drawn from the empirical analysis conducted in this project.

The first main conclusion drawn from the analysis carried out is that the use of reinsurance seems to be well explained by optimal capital structure theory-based arguments. The empirical results obtained in this study support the proposed hypothesis that users of reinsurance in the UK non-life insurance markets have a comparatively lower cost of equity than their counterparts without any reinsurance cover. This could reflect that investors in the UK's non-life (property-liability) insurance market incorporate the risk reduction achieved by diversification through reinsurance in their return expectations. Reinsurance can also reduce agency incentive conflicts between shareholders and managers, thus aligning managers' interests with that of the shareholders. These factors can result in shareholders demanding lower returns for their investment because they perceive a well-reinsured insurer to be a lower risk investment capable of producing the required rate of return with a higher degree of probability.

As predicted by the 'reinsurance volume decision' hypothesis (H2), the study finds that there is a non-linear convex (U-shaped) relation between the extent of reinsurance use and the UK-based non-life insurers' cost of equity. This result accords with the theoretical predictions made in Froot (2007) and Froot and Stein (1998) which suggest that risk management remains a value-added activity unless the associated costs exceed the cost of the risk of loss being mitigated. This result is also in line with the empirical findings of Purnanandam (2008) which hint at the existence of optimal capital structure, and that of Zou (2010) which show that the relation between the extent of property insurance use and the firm value is graphically concave (i.e., an inverted U-shape). The results reported in Table 7.7 suggest that the inflection point occurs approximately at the 50th percentile of the sample of firms. This statistic shows that for about half of the non-life insurance firms, which cede less than or equal to a quarter of their gross premiums written, reinsurance results in a reduced cost of equity; whereas for the other half, reinsurance drives-up the cost of equity. This observation implies that the prudent use of reinsurance can lower the cost of equity for insurers by providing surety of

return. On the other hand, excess reinsurance can result in the cost of reinsurance exceeding its benefits (in terms of lowering of frictional costs), which in turn increases the cost of equity for insurers. This finding also indicates that reinsurance is an important instrument at an insurer's disposal to achieve an optimal capital structure in inefficient financial markets.

Empirical results obtained for the control variables used in this study are mixed in regards to consistency with prior empirical research and finance theory. As predicted, leverage and liquidity are found to be positively related to the cost of equity across a majority of the estimators employed in this study. It is well documented in the academic finance literature that leverage increases the riskiness of a firm and leads to an increase in the cost of equity. Further, an observed positive relation between liquidity and the cost of equity adds weight to the argument made by Borde et al. (1994) that insurers holding a greater proportion of liquid assets (such as cash) tend to make riskier investment choices. In line with expectations, insurers having more capital resources relative to their stated liabilities tend to have a lower cost of equity, as higher capital levels improve investors' confidence that the insurance firm is likely to be a going concern. Similarly, a greater level of product market diversification leads to a lower cost of equity for UK-based non-life insurers, as the coefficient estimate corresponding to the variable used as an inverse proxy for product diversification is positive. Mixed results are obtained in regards to relation between firm size and cost of equity. However, a negative relation is found between firm size and the cost of equity in two out of three estimators for which this relation is statistically significant. This finding suggests that large non-life insurance firms are perceived by investors to be less risky than smaller firms because larger firms tend to be more diversified, both in terms of geography as well as in the range of products that they sell. Moreover, larger non-life insurance firms tend to have more resources at their disposal than smaller entities. All these factors result in relatively lower costs of equity capital for larger insurers.

8.4 Contribution of the Research

New insights into the reinsurance-cost of equity relation in the UK non-life insurance sector are provided by this research project. The study contributes to the existing insurance and finance literature by generating regulatory/practical implications in at least following four important regards:

This study is believed to be the first to provide empirical evidence on the impact of reinsurance purchase on the cost of the equity of an insurer. The findings of this research provide useful insights for assessing a firm's future profitability, riskiness and market value. The empirical evidence provided by this study suggests that investors take account of reinsurance purchased in assessing risks associated with an insurer's business, and thus in pricing its securities. Managers can also use this information to optimise the capital structure of their respective employers resulting in the minimisation of the prospective cost of equity, and other frictional costs arising due to market imperfections. Moreover, an optimal reinsurance (risk management) policy can reduce the level of retained share capital resulting in the maximisation of reported returns on equity. This insight could help policyholders and shareholders to make better informed choice decisions and potentially assist regulators to design and develop capital maintenance rules.

Most previous studies have focussed on financial derivatives while attempting to explain the impact of risk management on firm value (e.g., see Allayannis and Weston, 2001; Gay et al., 2011; Géczy et al., 1997; Haushalter et al., 2007). Moreover, derivatives' data are not only 'noisy' and difficult to interpret, but may not be able to completely eliminate the risk exposure (Haushalter, 2000). In contrast the current study focuses on reinsurance which not only is a pure indemnity contract, but provides a prospectively rich and publicly available (in the case of the UK) dataset to use in this research project. Therefore, this study provides cleaner evidence for the cost of equity – risk management relation within the UK non-life insurance market because of the 'pure-hedge' nature of reinsurance and the sufficiently large dataset employed to test the hypotheses. In this regard, the study provides a 'solid' basis for further academic research on the role of corporate hedging and its impact on the market value of firms. This could

be of interest to investors, financial analysts, and credit rating agencies amongst others.

Since investment financing and risk management decisions are inextricably bound, it is imperative to control for endogeneity induced by such a relationship. This study tests the cost of the equity – reinsurance relation using a battery of tests to ensure the validity of the results. Moreover, the IV is employed to check the robustness of the results. Another factor that adds to the reliability of the results obtained in this study is the fact that the UK insurance market operates under a unitary regulatory/fiscal regime. Not only this, the absence of premium rate regulation and regulator imposed purchase of reinsurance alleviates the possible effects of bias induced by such regulatory practices. This is because reinsurance purchase decisions and premium ratemaking (including reinsurance premiums) in the UK non-life insurance market are free managerial choices. Accordingly, the results of this research are unlikely to be unduly confounded by regulatory effects. This attribute furthers the potential contribution of this research project as a potential benchmark for future academic inquiry.

It is also believed that this study is the first to combine the full information beta method of Kaplan and Peterson (1998) with the non-parametric method of equity beta estimation described in Wen et al. (2008) to arrive at a firm-level equity risk premia. This is a novel technique for the cost of equity estimation that encompasses all organisational forms and accounts for all the ‘moments’ of the return distribution. This allows the cost of equity estimates to incorporate all the risk factors priced by investors while maximising the sample size. Therefore, this method is considered to be superior to other common asset pricing models such as the CAPM. As a result, it is considered that the present study makes a prospectively useful methodological contribution to the literature.

8.5 Limitations of the Study

Inferences drawn from this study are subject to certain inherent limitations, and should be interpreted as such. Although every possible care has been taken to minimise their impact, their influence on the results of this study must be

acknowledged. The first limitation arises because data unavailability eliminated the use of the valuation-based cost of equity metrics in this research. As most of the firms in the estimation sample are not publicly traded, the valuation based cost of the equity measures relying on a long time series of analysts' forecasts had to be ruled out. These metrics have been reported to correspond better with firm specific risk factors in comparison with asset pricing-based models such as the CAPM (e.g., see Botosan and Plumlee, 2002).

Second, the regulatory changes that have taken place during the study period have altered the format of the statutory returns filed by the insurers. The data provider (Standard & Poor's) has mapped the information in returns with the old format into the new format with due diligence, but few newly introduced data items are not available for years prior to the implementation of these changes. This limitation has been overcome by combining the new data items to synthesize the same information as presented solvency reports with the old format. Therefore, this limitation is unlikely to adversely influence the main inferences drawn from this study.

Third, the UK's non-life insurance sector has seen some merger and acquisition activity over the period of this study. To account for changes in the risk profiles of firms brought about by these activities, firms that underwent any major merger/acquisition are treated as different entities pre-and-post merger. This treatment is assumed to sufficiently address the issue of change in risk profiles of insurers undergoing a merger/acquisition.

Finally, as is the case with any study concentrating on the UK non-life insurance sector, the results of this study may not be completely generalisable to other jurisdictions/countries with different regulatory and market structures. Any effort to generalise these results to different contexts should therefore be tempered by considering the impact on the reinsurance – cost of equity relation of the institutional features of the respective environment.

8.6 Areas for Future Research

The results presented in the current study hint at some prospective areas for future research. First, the current study can be enhanced by incorporating other potentially relevant variables subject to data availability. For example, future research could explore the differences in the effect of different types of reinsurance treaties on the cost of equity, and firm value. Moreover, a comparison between the impact of hedging on the cost of equity through different techniques such as financial derivatives and insurance can help identify the optimal mix of financial risk management techniques to achieve risk management policy objectives. Further, variations in the impact of financial hedging across the different lines of insurance can also advance our understanding of the relation between risk management, cost of equity and firm value.

Second, alternative metrics, such as mark-to-market accounting-based cost of equity estimation models, could be employed in any future research to test the relation between the cost of equity and reinsurance. Due to the absence of a universally accepted cost of equity estimation model, it is imperative that any study investigating the relation between reinsurance and the cost of equity uses more than one estimate of the cost of equity to establish the robustness of estimates.

Third, future research could explore the risk management-cost of equity relation in other industrial sectors such as banking. Although the results from the current study are not directly applicable to non-insurance industrial sectors, they can nonetheless provide a broad framework within which the cost of equity-risk management relation can be analysed.

Fourth, the findings of the current study can be complemented by examining the link between risk management decisions and the dispersion of corporate share holdings. For example, future research could examine whether ownership/diversification influences risk/hedging decisions in particular ways. It is important because firms with a more diversified and larger investor base are perceived to be less risky by the financial markets (Mackey, Mackey and Barney, 2007).

8.7 Final Remarks

Many stakeholders including investors, managers and regulators attach considerable importance to corporate risk management and its effect on firm value. Substantial academic research has been conducted in this area, but consensus regarding the impact of financial hedging on firm value remains elusive. However, much of this research has attempted to analyse the impact of financial risk management (hedging) on firm value either by concentrating on the overall market value of the firm or by focusing on its impact on a firm's cash flows. This study enriches the extant literature by investigating the effect of corporate hedging on the cost of the equity of non-life (property-liability) insurers, an important determinant of a firm's traded value. By focusing on insurance companies this study also addresses the dearth of research in the field of risk management of financial intermediaries. Despite its limitations, the study makes a potentially important contribution to the finance and risk management literature by demonstrating that the cost of equity-reinsurance relation in the case of insurance companies is non-linear. The theory of optimal capital structure also finds support from the empirical evidence presented in this study, suggesting that financial markets are indeed inefficient. These insights can lead to better informed decision-making by managers, investors, policyholders, insurers and other stakeholders such as credit rating agencies. Finally, this study provides a basis for further research that investigates the impact of risk management on firm value through different channels (e.g., financial derivatives) and extends the applicability of this research across different sectors of the economy (e.g., the banking sector).

APPENDIX A

Using the Bootstrap Method for Estimating Industry Betas

Calculation of industry-level annual betas using the bootstrap method in this study entails a six step process. Following are the steps involved in this process:

1. First, the degree of risk aversion parameter 'b' is calculated for each month as described in equation 5.13 of Chapter 5. This equation utilises monthly returns on non-life insurance sector index (FTSE 350 Non-Life Insurance Index) and the market index (FTSE All-Share Index) to calculate this parameter.
2. Next, the median of monthly values of risk aversion parameter 'b' calculated in step 1 is estimated to represent the risk aversion parameter in subsequent calculations.
3. The bootstrap method as employed in this study involves randomly selecting returns, with replacement, from the full sample of actual monthly returns at market and industry level respectively to generate a series each of market and industry returns of the same sample size as the original data.
4. The median value of risk aversion estimated in step 2 is then used in conjunction with returns' series constructed in step 3 to generate an industry level beta estimate as per equation 5.14 of Chapter 5.
5. Steps 3 and 4 are then repeated a desired number of times (1560 in this study) to generate a sufficiently long series of beta estimates.
6. Next, the average of the first sixty beta estimates obtained in step 5 is assumed to represent the true beta for the year 1985, and the mean of the next sixty estimates for the year 1986 and so on to get 26 estimates of beta corresponding to each year from 1985 to 2010.

The annual beta estimates obtained above are then used to estimate product-market level betas, leading on to firm level beta estimates, as explained in section 6.4 of Chapter 6 of this thesis.

APPENDIX B

Calculation of Reserving Errors Using the KFS Method

The calculation of reserving errors using the KFS method (see section 6.7) can best be explained by using an example. As noted in section 6.7 of Chapter 6, the following equation is used by the KFS method in calculating reserving errors:

$$Reserve\ Error_{i,t} = Incurred\ Losses_{i,t} - Incurred\ Losses_{i,t+n}$$

Subscripts ‘i’ and ‘t’ in the above equation denote firm and year respectively. For simplicity, the following explanation omits subscript ‘i’, and focusses on loss development for a single firm over time. Incurred losses in ‘x’ most recent accident years to accident year ‘t’ can be calculated as:

$$Incurred\ Losses_t = \sum_{j=t-x}^t Reported\ Claims_{j,t} + \sum_{j=t-x}^t IBNR\ Claims_{j,t}$$

In this study the losses incurred in the two most recent years in the past (i.e., x=2) have been used to calculate incurred losses. Incurred losses corresponding to accident years ‘t-x’ to ‘t’ in accident year ‘t+n’ are calculated as:

$$Incurred\ Losses_{t+n} = \sum_{j=t-x}^t Reported\ Claims_{j,t+n} + \sum_{j=t-x}^t IBNR\ Claims_{j,t+n} + \sum_{k=t+1}^{t+n} \sum_{j=t-x}^t Net\ Claims\ Paid_{j,k}$$

This study sets n=1, i.e. losses corresponding to year ‘t’ to ‘t-2’ are calculated in year ‘t+1’ to estimate reserving errors for a particular firm in year ‘t’.

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